User Excellence Awards entry form page 16

NETWORK WORLD

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IBM VAN unit eyes frame relay, LAN link services

By Barton Crockett
Senior Editor

TAMPA, Fla. — An IBM Information Network (IIN) official last week said the service provider is likely to add frame relay support and multiprotocol LAN routing services to its suite of Systems Network Architecture-based transport services.

Dave Foster, IIN senior analyst for architecture and design, said he believes IBM will begin offering the international frame relay service after it rolls out frame relay support for its 3745 front-end processors — which anchor the IIN — in the fourth quarter of 1992.

Foster declined to speculate when the IIN might begin offering multiprotocol local-area network routing services or to specify in greater detail when frame relay service would debut.

But James Harrison, program director for global network services at the META Group, a market research firm in Westport, Conn., said he does not expect IIN's frame relay and routing services before 1993.

Ellen Hancock, vice-president

(continued on page 5)

Banyan marketing VP James D'Arezzo at SCO Forum91.

Users press on with GOSIP trials despite hang-ups

By Ellen Messmer
Washington Correspondent

WASHINGTON, D.C. — One year after federal agencies were ordered to support the Government Open Systems Interconnection Profile (GOSIP), a handful of pioneering users are setting the pace.

But few federal agencies today have made much progress toward a full GOSIP cutover, hampered in part by a protracted procurement process that bogs down migration plans, as well as by products that require extensive testing and custom integration.

Despite these limitations, GOSIP leaders such as the departments of Defense and Veterans Affairs said they are gaining valuable experience with OSI product trials that will enable them to refine their network plans and be better prepared to implement OSI products as they come to market.

"There's no one cookie cutter solution," said Walter Houser, policy officer at the Department of Veterans Affairs (VA). "The issue is: Are there products mature enough for a national networking strategy? We're trying to evaluate that now."

Last August, the Department of Commerce issued GOSIP as a federally mandated policy and instructed agencies to comply with it. GOSIP is a collection of communications standards devel-

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Banyan unwraps net capabilities for Unix

Teams up with The Santa Cruz Operation to offer VINES features for SCO Unix; other deals on tap.

By Timothy O'Brien
West Coast Bureau Chief

SANTA CRUZ, Calif. — Banyan Systems, Inc. and The Santa Cruz Operation, Inc. (SCO) last week said they will jointly develop versions of Banyan's distributed network services, such as directory services and wide-area networking capabilities, for use with SCO's popular Unix operating system.

While the announcement — which was expected — lacked any real details, it represents an important first step for Banyan in its strategy to make key components of its VINES network operating system available for standard Unix platforms, other network operating systems and applications.

"Banyan is now positioned to provide its network services software on other industry platforms," said James D'Arezzo, Banyan's vice-president of marketing.

The companies said the joint effort was aimed at providing users with an open, standards-based Unix platform that will provide extensive enterprise networking capabilities.

"With these services, an SCO Unix system will look just like a VINES server to a user," said Barry Brown, director of strategic product planning at Banyan.

The companies claimed that the addition of Banyan's network services software would better in-

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INSIDE

DATACOM BUYER'S GUIDE

DSU/CSUs meet data needs of net managers, page 31.

Beta tester lauds MCI's switched T-1

By Bob Wallace
Senior Editor

STAMFORD, Conn. — General Electric Capital Corp., which began beta-testing MCI Communications Corp.'s switched T-1 service in June, now plans to use the service to support emerging LAN interconnection and imaging applications.

GE Capital said the switched T-1 service performed flawlessly as a backup to regular T-1 links used for local-area network interconnection and is far less expensive than the equivalent number of switched 56K bit/sec links.

"The switched T-1 service exceeded our expectations by performing superbly," said Greg Casagrande, GE Capital's enterprise network manager. "I was surprised because when you test a new service, you expect problems with it. But we didn't have any."

Announced at the Tele-Communications Association, Inc.'s

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NETLINE

USERS, VANS SPLIT over effectiveness of ANSI Mailbag standard for swapping EDI files between net services. Page 2.

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AT&T RIVALS CLAIM carrier is defying FCC order by continuing to bundle 800 services under Tariff 12 deals. Page 4.

VENDORS AIM TO BUILD facsimile services into applications with new API. Page 4.

CONTINGENCY PLANNING helps network users weather the wrath of Hurricane Bob without suffering lingering outages. Page 53.

NEWSPAPER

FEATURE

Planned super networks foreshadow 21st century

By James Kobielus
Special to Network World

No one can predict exactly what tomorrow's high-speed wide-area networks will look like. But we can get a glimpse of the future by examining five federally funded research projects likely to result in WANs that function at speeds in the gigabit-per-second range.

The high-speed network test beds — dubbed Aurora, Blanca, Casa, Nectar and Vistanet — will be used to explore concepts that will form the basis of the proposed National Research and Education Network (NREN).

Some members of Congress and various other proponents of NREN envision it as an upgrade or offshoot of the National Science Foundation Network (NSFNET). NREN is designed to provide high-speed, real-time connections between computers at government, commercial and academic research institutions.

The five test beds are taking different approaches and addressing varied research ques-

(continued on page 43)

New EDI message standard criticized by users, vendors

Some fear Mailbag hinders X.435 development, does not provide functionality of X.400 gateways.

By Wayne Eckerson
Senior Editor

The ANSI X12 Task Group recently approved a new standard designed to improve the reliability of interconnections between EDI network services, but not all users and network providers are happy about it.

The new standard, known as the Interconnect Mailbag Structure, is an attempt to improve upon the existing method of transferring electronic data interchange messages between network services — an approach many have characterized as "dial, dump and pray."

Users have complained about the current lack of controls and audit trails, which make it impossible to detect, find or resend lost or improperly addressed EDI messages.

But some members of the EDI community say Mailbag does not meet users needs and vendors should be devoting their resources to developing X.400 gateways between their networks rather than implementing Mailbag. Others fear that Mailbag will slow the implementation of X.435, a recently approved CCITT standard designed specifically for transmitting EDI documents over X.400 networks.

"Mailbag is leading us down a path that is not in the best inter-

(continued on page 54)

Telematics devises strategy to add frame relay support

PCP packet switches to get support by year end.

By Bob Brown
Senior Editor

FORT LAUDERDALE, Fla. — A year after scrapping its first frame relay product, Telematics International, Inc. last week announced plans to enhance an existing interface to support the emerging packet-switching standard.

The company said that by year end it will roll out NET25 Frame Relay, software that will enable an existing communications board for its NET25 Programmable Communications Processor (PCP) family of packet switches to support frame relay.

In the first quarter of 1992, Telematics will detail plans to support frame relay on its DX T-1/E-1 multiplexers, and by the end of next year, it will unveil support for frame relay on its low-end Access Communications Processor (ACP) packet switches and packet assembler/disassemblers.

The company will hold its premier demonstration of frame relay products on Oct. 7 at the INTEROP 91 Conference and Exhibition in San Jose, Calif., and the Telecom '91 conference in Geneva.

Lawrence Cattell, Telematics' senior vice-president of marketing, said the company has adopted a phased approach to imple-

(continued on page 6)

FCC brands radio frequency sharing tests inconclusive

By Bob Wallace
Senior Editor

WASHINGTON, D.C. — The results of the first test to determine if microwave users can share radio frequencies with emerging wireless communications carriers are inconclusive, according to a Federal Communications Commission letter obtained by *Network World*.

In its letter to wireless communications operator PCN America, Inc., which coordinated the frequency sharing tests with the Houston Area Microwave Users Group (HAMUG), the FCC prohibited PCN America from beginning the next stage of its service rollout until further tests are conducted.

"We have very clear frequency sharing concerns that have to be addressed before PCN America proceeds with its experiment," said Thomas Stanley, the FCC's chief engineer and author of the letter. "There are questions about sharing that need to be clearly answered to the satisfaction of all."

In the test, users created several 2-GHz microwave paths and PCN America used special equipment to generate signals in the

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Briefs

Newbridge enhances MainStreet. Newbridge Networks, Inc. this week will announce a series of enhancements for its MainStreet T-1 multiplexer family that let the device function as a multipurpose communications processor, according to Jim Michaels, assistant vice-president of strategic marketing and product planning for the company.

Newbridge will add modules that enable its 3645 and 3600 MainStreet multiplexers to act as local-area network hubs for Ethernet and, eventually, for token-ring LANs. Newbridge will also announce a new packet switching interface module that supports frame relay. The module has five times the processing power of its existing frame relay switch and can fill a 10M bit/sec circuit without delays. Additionally, the company will unveil enhancements that enable users and carriers to partition MainStreet-based nets into multiple logical networks, Michaels said. At the Telecom '91 show in Geneva this October, Newbridge will introduce its new high-end multiplexer, the 36150 MainStreet, which will be based on Synchronous Optical Network standards.

AT&T pulls plug on VSN service. AT&T last week pulled the plug on its Virtual Signaling Network (VSN) offering, a service designed to allow independent telephone companies to use AT&T's Common Channel Signaling System 7 (CCS7) network to offer advanced services. Announced in September 1989, VSN was targeted at phone companies that wanted CCS7 benefits, such as faster call setup, but couldn't justify building their own signaling network. AT&T began marketing VSN early this year but could not find any takers.

WilTel blames decline on Tariff 12. In recent meetings with Federal Communications Commission officials, WilTel said it has lost about 10% of its commercial revenues due to customers switching to Tariff 12 deals. The carrier said AT&T holds about 74% of the total private-line market and 20% of that figure is locked up in Tariff 12 deals.

UAOS develops business cases. The Business Case Working Group of the User Alliance for Open Systems (UAOS) last week met and hammered out several action items it plans to address this fall. The 20-member group first agreed to put together guidelines to help users write business cases for migrating to open systems. The group's primary goal is to establish a repository of such business cases that others can use as reference.

The working group also agreed to recruit specialists, such as accountants and project managers, to write white papers that address specific parts of writing a business case, such as selecting the economic measurements to determine the benefits of training. For more information, call Chuck Gardner at (716) 724-2265.

Wellfleet mgmt. programs to bow. Wellfleet Communications, Inc. this week will announce a plan dubbed Advanced Internetwork Management under which the router vendor will provide Simple Network Management Protocol (SNMP) net management applications. The programs will run on any make of SNMP management station.

AT&T, IDB get nod for Soviet service. AT&T and IDB Communications Group, Inc. of Culver City, Calif., last week received temporary authority from the Federal Communications Commission to use 24 64K bit/sec circuits on the Intersputnik satellite system to provide international switched telephone service between the U.S and the Soviet Union. No U.S. carrier has ever used the Intersputnik satellite system, which is owned by the Soviet Union and its former allies.

AT&T and IDB will be able to use the circuits until the FCC makes a final decision on which U.S. carriers will receive the 90 Intersputnik circuits the U.S. was granted by the International Telecommunications Satellite Organization earlier this year. AT&T has 67 phone circuits between the U.S. and the Soviet Union, but calling volumes outstrip capacity and 2,300 circuits are needed, the carrier said.

Net management remedy. Remedy Corp., a Sunnyvale, Calif., start-up, will introduce its first product at a press briefing in Boston on Sept. 4. Remedy is expected to unveil network management applications designed to be integrated with existing network management systems from vendors such as Hewlett-Packard Co., Novell, Inc. and Sun Microsystems, Inc. The products will be primarily focused on local-area networks.

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MFS offers LAN internet service line

By Bob Wallace
Senior Editor

NEW YORK — As expected, Metropolitan Fiber Systems, Inc. (MFS) last week introduced a line of fiber-based services designed to support LAN interconnection at speeds up to 100M bit/sec.

The carrier's four new MetroFiber MultiMegabit Data Services (MDS) include equipment and circuits that enable users to interconnect Ethernet and token-ring local-area networks, as well as support high-speed workstation-to-host applications.

MFS is now offering the services on its 849-mile fiber-optic Houston network that serves 30 buildings downtown. The company plans to extend MDS to MFS networks in 10 other cities during the next 12 to 18 months to accommodate customer demand.

"We anticipate a huge customer demand for these high-speed services," said Royce Holland, MFS president and chief executive officer.

The first of the MDS offerings, MetroFiber MDS FDDI Virtual Connection, enables users to link Fiber Distributed Data Interface nets across a metropolitan area at speeds up to 100M bit/sec.

The service provides a so-called "virtual connection" between LANs, meaning subscribers send traffic over a shared 100M bit/sec fiber link. As a result, users may encounter data delivery delays caused by contention problems during peak traffic periods, Holland said.

If traffic exceeds the bandwidth of the shared link and contention becomes troublesome, MFS will divert traffic onto a second 100M bit/sec FDDI backbone to handle the additional traffic, he said.

MFS declined to quote prices for MDS, saying cost is determined on a user-by-user basis.

Another newly announced service, MetroFiber MDS Ethernet Connection, is available in three versions: fractional, dedicated and virtual.

The fractional version enables users to link Ethernets within a metropolitan area at 1.544M bit/sec, while the virtual and dedicated varieties support transmission at 10M bit/sec.

Users that want to link Ethernets but have low traffic demands would use the fractional version. "It's a price/performance tradeoff," Holland said. "Some users may be able to get by with a slower link and save the money they

(continued on page 6)

FCC calls for reduction of int'l rates

By Anita Taff
Washington Bureau Chief

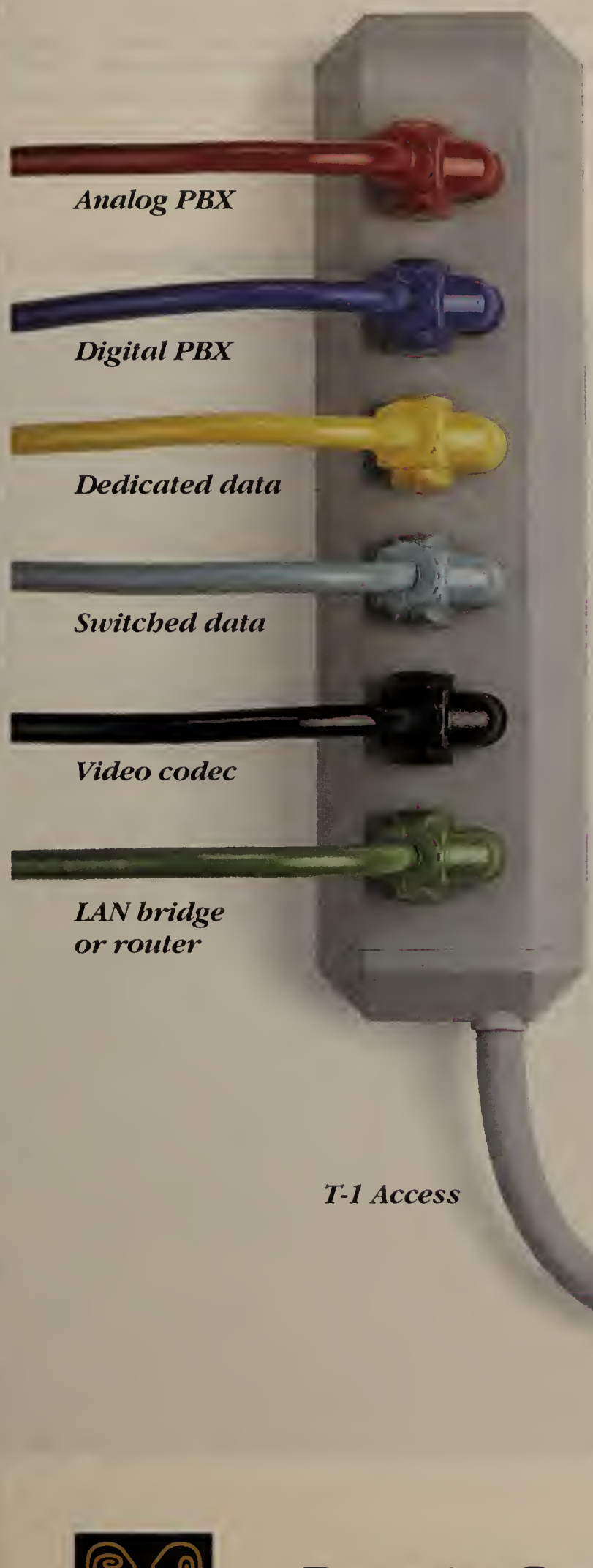
WASHINGTON, D.C. — FCC Chairman Alfred Sikes last week told the largest U.S. providers of international service that if they can't bring down international accounting rates by 1993, the agency will step in to set rates.

In a closed-door meeting with AT&T, GTE Telephone Co., MCI Communications Corp., TRT/FTC Communications, Inc. and US Sprint Communications Co., Sikes underscored his determination to bring foreign carriers' accounting rates — and thus international service pricing — more in line with the actual cost of providing service.

Accounting rates are the charges paid by U.S. carriers to foreign service providers for terminating calls in other countries. These rates are a key factor in the pricing of international services. Sikes has claimed that foreign carriers' accounting rates may be set as much as 50% above actual costs.

Last week, he urged U.S. carriers to continue to press their foreign counterparts for lower rates through individual negotiations. But he warned, "We believe we

(continued on page 5)



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API would enable developers to build fax services into applications

By Bob Brown
Senior Editor

BERKELEY, Calif. — A dozen vendors last week unveiled an new application program interface (API) that would enable software developers to build facsimile services into applications.

The FaxBios API is designed to let users initiate faxes from within word processing, spreadsheet or other applications for transmission via a wide variety of fax boards or servers.

The newly created FaxBios Association — whose members include Everex Systems, Inc., Hewlett-Packard Co. and WordPerfect Corp. (see graphic, this page) — will promote vendor acceptance of the FaxBios API.

Currently, vendors are forced to develop application-specific links to different brands of fax boards or servers, a daunting and expensive task that limits the number of fax products an application can use.

According to Richard Holder, manager of corporate lab at WordPerfect and the FaxBios Association's information officer, the FaxBios API is designed to help remove these and other obstacles to computer fax growth.

"Users want to integrate faxing capabilities into their applications, as they can already do with printing or E-mail capabilities," he said. "What they don't want to worry about is which fax boards and servers will work with which applications."

Holder added that building interfaces between many combinations of fax products and applications is expensive for vendors.

Products from applications and fax vendors supporting the FaxBios specification are expected to start shipping in the fourth quarter, according to a spokesman for Biscom, Inc., an association member that makes fax servers.

The implementation of FaxBios in products will only become useful, however, once a critical mass of vendors support the API, Holder acknowledged. So far, WordPerfect is the only major applications developer to publicly announce its support for the API.

The association is expected to act as an overseer of the FaxBios specification for the next one to two years, after which the group's membership will determine whether FaxBios should remain a de facto standard or be turned over to an established standards body.

The FaxBios Association plans to release the FaxBios specification on Oct. 1, by which time the specification should be refined, Holder said.

Membership to the association will be opened to other industry members at that time.

FaxBios Executive Committee

- Alcom Corp.
- Biscom, Inc.
- Corel Systems Corp.
- DCE Corp.
- Discovery Data Systems, Inc.
- Everex Systems, Inc.
- Fremont Communications Co.
- Hewlett-Packard Co.
- Matsushita Graphic Communication Systems
- Optus Software, Inc.
- WordPerfect Corp.
- XTree Co.

SOURCE: FAXBIOS EXECUTIVE COMMITTEE
GRAPHIC BY TERRI MITCHELL

Rivals say new Tariff 12 deals disobey FCC rule

By Anita Taff
Washington Bureau Chief

WASHINGTON, D.C. — AT&T rivals last week filed protests against 15 new Tariff 12 contracts, claiming the custom net deals are illegal because they include toll-free 800 services in defiance of a Federal Communications Commission ruling.

MCI Communications Corp., US Sprint Communications Co. and WilTel are asking the FCC to reject all of the new deals, Options 93 through 107, filed since Aug. 1.

They are crying foul because on Aug. 1, the FCC told AT&T it could no longer include 800 services in Tariff 12 offerings because it has 80% of the 800 market and users cannot retain their 800 number if they switch carriers. The agency did, however, grandfather all existing deals.

Despite this prohibition, AT&T has filed 15 new Tariff 12 packages, all of which contain 800 services (see graphic, page 6). AT&T officials say they are unclear when the ban against bundling 800 is supposed to take effect, and they will continue to file deals until they get official notice.

(continued on page 6)

1975 *Launched the first U.S. public data network.* 1979 *Built the first commercial private packet network.* 1980 *Introduced the first major public e-mail service.*

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1988 *Sprint completes the only nationwide 100% digital fiber optic network. Sprint awarded 40% of FTS 2000 contract.* 1989 *World's first and largest privately-owned*

IBM VAN unit eyes frame relay

continued from page 1

and general manager of IBM's Networking Systems group, acknowledged in a recent interview that there are several hurdles to overcome before frame relay would be available on the IIN.

"What's not easy is making agreements with each carrier, testing with them and making a business case for the offering," Hancock said.

Even though IBM's new services are probably years away — if they are to appear at all — these moves fall in line with efforts by international value-added network (IVAN) service providers around the world to introduce new alternatives to traditional X.25 packet-switching services.

"The thing that is most important to users is that the range of choices available is expanding very rapidly," said Ron Bamberg, vice-president of BT North America, Inc. in San Jose, Calif.

IVAN providers are focusing on three new services. The first is frame relay, which BT North America, Infonet Services Corp. and US Sprint Communications Co. plan to begin offering internationally later this year. Frame relay promises less network delay in high-bandwidth applications than X.25.

IVAN providers are also introducing new router-based LAN internetworking services. Infonet and US Sprint recently began offering these services commercially. Thirdly, IVAN providers are beginning to lease dedicated capacity to users. Within the past year, Infonet and US Sprint have begun doing this, while BT North America said recently it will follow suit.

Foreign carriers are also introducing new internetworking services. Among them is Telecom Finland, which last week introduced what it called the first public frame relay service in Europe. The service is available only in Finland and supplements a router-based LAN internetworking service the carrier has provided since 1989.

France Telecom, however, is taking a different tack. The carrier hopes to meet evolving needs for high-speed services by cranking up the speeds supported by its X.25 packet-switched network, according to Gerard Simonet, director general of France Telecom's Transpac packet-switching unit.

He said Transpac plans to begin offering 2M bit/sec X.25 public packet service next year. The unit already offers packet services at speeds up to 266K bit/sec. Transpac will also begin offering frame relay access to its X.25 public packet service next year, primarily to serve users that deploy frame relay in private nets or in other countries.

Transpac believes high-speed X.25 services will be adequate for users' LAN internetworking requirements for the next three to five years.

85 *Sprint introduces the world's first VPN.*sm 1986 *First transcontinental fiber optic call transmitted by Sprint.* 1987 *Eight million FONCARDs*sm *distributed in first year.*

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nsatlantic fiber optic cable completed. 1990 *Sprint announces the first commercial video services to the Soviet Union. Sprint introduces first nationwide ISDN capabilities.*

FCC calls for int'l rate reductions

continued from page 3

have the legal authority to disapprove unreasonable accounting rate agreements and are prepared to do so beginning in 1993."

Sikes and other U.S. officials say it is increasingly urgent to rein in international rates since this country has a deficit in telecommunications services that is currently $3 billion annually and growing. The deficit is fueled by the higher rates charged by international carriers and higher volume of outgoing than incoming calls to the U.S.

While Sikes was meeting with carriers, suggestions were pouring in from regulators and other service providers about how the Federal Communications Commission could bring international rates closer to cost.

The comments were in response to an FCC proposal to establish an analytical framework for determining which accounting rates are out of line. The agency would then determine ways to bring down rates, including the possibility of mandating rates paid to foreign carriers. The FCC opened a proceeding to examine international rates last July.

Although most in the industry agree that international rates are a problem, some question whether the FCC has the authority to mandate rates. The agency would likely have to coordinate any decision with other U.S. agencies, such as the Department of State, Department of Commerce and the U.S. Trade Representative.

Not everyone thinks the FCC's approach of threatening to impose rates on foreign carriers will work. "The U.S. carriers cannot unilaterally impose the commission's agenda," GTE said. "The commission appears to be sending a dark message: either lower your accounting rates to the level we think is reasonable or be blacklisted."

GTE said the FCC must work with other organizations such as the Consultative Committee on International Telephony and Telegraphy.

The Caribbean Association of National Telecommunication Organizations (CANTO) also urged caution. "[CANTO] is troubled by the FCC's adherence to the principle of cost-based accounting rates independent of any methodology for measuring costs or allocating costs among service categories," the group said.

The National Association of Regulatory Utility Commissioners said FCC action is "necessary to ensure that U.S. consumers are not forced to pay unreasonable charges to foreign administrations."

Rivals say deals disobey FCC rule

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An FCC ruling is often not considered effective until the text of the order is printed in the federal register. But FCC staff members say they have the latitude to make the rulings effective immediately and that the agency intended for the ban against bundling 800 to take effect Aug. 1, the day of the decision. The order is expected to be released in September.

AT&T rivals claimed in filings last week that the carrier is fully aware that the ban on 800 took effect Aug. 1 and that AT&T is trying to thwart the FCC' authority by continuing to file Tariff 12 deals with 800 service.

"Instead of revising its practices to eliminate the unlawful bundling, AT&T reacted to the Aug. 1 decision by quickly filing a series of new options, each containing 800 bundling," WilTel stated in its filing.

US Sprint agreed. "AT&T's filing of these new Tariff 12 options on the heels of the Aug. 1 meeting demonstrates its utter disrespect for the commission's processes," the carrier said in its filing.

MCI was less kind. "Clearly, the 15 new Tariff 12 option proposals that AT&T has filed since Aug. 1 — an unprecedented volume in so short a period — convincingly demonstrates that AT&T fully grasps the import and meaning of the commission's Aug. 1 decision and is attempting in no uncertain terms to circumvent, indeed thwart it."

According to Tom Norris, AT&T corporate vice-president for regulatory affairs, the carrier is trying to protect customers. He said AT&T is no longer opening negotiations on new Tariff 12 deals but it will continue to file deals in progress.

"We will keep filing Tariff 12 deals as they come off the pipeline and hope the commission will deal fairly with these customers," he said.

"The dislocation for a customer who had been working for a year or more on a Tariff 12, would be just as great as that for a customer who had a Tariff 12 actually in effect for a year," Norris said. "These things don't happen on the spur of the moment."

However, AT&T's rivals claim that allowing some Tariff 12 deals to trickle through after the Aug. 1 date would prove to be unworkable and would inevitably harm some customers. In its filing, MCI asked how far along a customer would have to be in negotiations with AT&T in order to say a deal was in progress, as well as how the FCC would determine the level of progress.

US Sprint said that because it can take as long as a year for customers to negotiate Tariff 12 deals, allowing those in progress to be grandfathered would completely subvert the intention of the FCC's decision.

Tariff 12 deals filed since Aug. 1

Option	Date filed	Millions of dollars (rounded) Annual revenue	800 revenue	800 as a percentage of total revenue
93	Aug. 2	$47.84	$19.06	39.84%
94		41.55	10.39	25.02
95		7.35	0.28	3.81
96		5.82	0.63	10.86
97	Aug. 5	11.82	0.34	2.86
98	Aug. 6	10.55	1.91	18.06
99		19.43	2.65	13.63
100	Aug. 8	8.70	1.56	17.88
101		8.86	1.33	15.06
102		4.98	1.57	31.47
103		8.74	1.51	17.24
104		6.21	0.85	13.71
105		7.24	0.32	4.46
106		4.58	0.49	10.79
107		8.29	0.48	5.77
	Total:	201.97	43.37	21.47

GRAPHIC BY SUSAN SLATER — SOURCE: US SPRINT COMMUNICATIONS CO.

Telematics devises strategy

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menting frame relay, allowing customers to migrate to the advanced service at their own pace.

"We see frame relay as very viable for certain applications, such as LAN-to-WAN interconnection, particularly where you have reliable transmission facilities," Cattell said. "But frame relay is not a panacea for all data networking requirements. We see it as complementary to the existing range of protocols we support."

Telematics made its initial foray into frame relay with the February 1990 launch of the Series 9000 Frame Relay Exchange, a high-perfomance network switch. But the product was abandoned when the company received negative feedback from users turned off by the offering's $50,000 to $130,000 price tag.

The company's revised strategy is designed to let users adopt support for frame relay in a more cost-effective manner by upgrading existing interface equipment.

Telematics' first frame relay offering is a software upgrade for its existing Transmission Control Processor (XCP) communications board.

The board itself was introduced earlier this year to support links between the company's PCP packet switches at speeds up to 2.048M bit/sec.

The company's PCP Model S4500 packet switch, which can be configured with as many as 480 ports, can accommodate one XCP card configured as a frame relay interface, and the PCP Model S5500, which can be configured with as many as 448 ports, can support two XCP cards. Both switches support maximum line speeds of 2.048M bit/sec.

Installing an XCP card on a PCP switch will enable users to support frame relay in addition to an assortment of other protocols, including X.25 and Transmission Control Protocol/Internet Protocol, Cattell said.

The NET25 Frame Relay software for the XCP costs $5,000 for implementation on a single PCP switch, while a license-to-copy option will be available for $2,000 per switch. A single XCP board supports eight channels with throughput capacity of 8M bit/sec and costs $12.500.

Future direction

The frame relay interface that Telematics plans to offer for its DX T-1/E-1 multiplexers next year will be called the Frame Exchange Controller interface. Each interface will support as many as 16 frame relay ports and a maximum bandwidth of 24M bit/sec.

For the low end of the company's product line, Telematics is developing a frame relay interface for its ACP family of switches and PADs that will enable the access products to support frame relay data communications equipment and data terminal equipment protocols and T-1/E-1 speeds.

Later, probably in 1993 or 1994, Telematics plans to roll out a new, packet-oriented switching platform designed to support emerging broadband services.

MFS offers internet line

continued from page 3

would've spent on a higher speed link."

Users that want to link Ethernets and have a higher throughput would use the virtual option in which they share a pipe with other users. However, users should be aware that they may experience some contention delays during peak traffic periods with the virtual option, Holland said.

Users with high throughput requirements who can't tolerate delays would use the dedicated version of the service, where traffic is sent alone over a dedicated connection.

Flat-rate pricing for the fractional version starts at $500 per site per month, while the dedicated option costs $1,400 per site per month and the virtual offering is $1,000 per site per month. Prices are based on a three-year contract, and there are no volume or usage charges.

The third service, MetroFiber MDS Token Ring Connection, lets users interconnect token-ring LANs within a metropolitan area at varying speeds and is available in the same three versions as the Ethernet Connection service.

The fractional version allows users to link token rings at 1.544M bit/sec on a shared line, while the virtual and dedicated versions support transmission at 4M or 16M bit/sec.

Pricing for the fractional version starts at $500 per site per month, the dedicated offering begins at $1,600 per site per month, and the virtual version starts at $1,500 per site per month. These prices are based on a three-year contract.

The fourth offering, MetroFiber MDS Computer Channel Extension, enables users to interconnect mainframe and supercomputers within a metropolitan area and support 2M or 4.5M byte/sec data transfer rates. The service supports IBM-compatible channel devices such as printers and terminal controllers, and comes packaged with a channel-attached bus and tag cable interface.

The service is designed to support disaster recovery, remote document printing and document processing. MFS declined to disclose pricing for the service but said it will be determined on a user-by-user basis.

Pricing for MDS includes connection at the user site as well as the bridge and router equipment MFS installs on the customer premises to support connection to the services.

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INDUSTRY UPDATE

VENDOR STRATEGIES, MARKET TRENDS AND FINANCIALS

Worth Noting

"I think the switched access equipment market is going to shape up a lot like the router market. The barrier to entry is low, so you'll soon see the small players that originated the market joined both by new start-ups as well as more traditional data communications vendors."

Todd Dagres
Director of data communications
The Yankee Group
Boston

People & Positions

Mitel Corp., a Boca Raton, Fla., maker of private branch exchanges, last week named **John Thomas** vice-president of sales for North America. Thomas, who will be responsible for government and commercial sales, will work from Mitel's North American executive office, scheduled to open in Reston, Va., in mid-September.

Andrew Lipman was named senior vice-president of legal and regulatory affairs at **Metropolitan Fiber Systems, Inc. (MFS),** an Oakbrook Terrace, Ill., alternate access carrier.

He will be responsible for directing MFS regulatory affairs and lobbying efforts, as well as implementing interconnection agreements with the regional Bell holding companies. Lipman will also be chairman of the MFS regulatory steering committee, which was created to further develop the company's regulatory policy and strategy.

Lipman will retain his partnership at Widler & Berlin, a Washington, D.C. law firm where he heads the telecommunications practice.

Microcom exec cautiously optimistic about the future

CEO Jim Dow talks about firm's strategic plan.

By Bob Brown
Senior Editor

NORWOOD, Mass. — Jim Dow, president and chief executive officer of Microcom, Inc., senses that a turnaround is taking place at his company, but he isn't ready to say so just yet.

"I don't know that after one good quarter you'd call anything a turnaround," said Dow, referring to Microcom's 55% revenue surge in the first quarter ended June 30. "People have a short memory of how good you were and how bad you were in this industry. We had five great years leading up to one real bad year. Our plans all during last year were to fix the business up and get ready for a good fiscal '92."

Dow said he is cautiously optimistic that Microcom — which sells modems, personal computer communications software and bridges — is on the rebound after what he acknowledged as a terrible 1991. Microcom, based here, reported four straight unprofitable quarters in fiscal 1991 after a string of 17 consecutive quarters of earnings growth.

Distribution problem

According to Dow, distribution was Microcom's major problem last year — the company had stuffed the channels too full of products. Microcom spent the past year "bleeding those channels," he said, cutting back on production and selling fewer products to the distributors.

Microcom also took a charge of $2.5 million against earnings in the second quarter of fiscal 1991. That was associated with layoffs and restructuring of operations, a company spokesman said.

"We needed to get operationally restructured so that if we had the right products and marketing programs, we could begin to rebuild our earnings," Dow said. "Now we're poised to let the marketplace determine whether our products are competitive or not."

Paul Johnson, a vice-president at First Boston Corp., a New York investment firm, said Microcom has made the right moves to get back on track. "But a turnaround will be based largely on new product flow," he said, adding that Microcom needs to focus resources on hot markets, such as internetworking.

Microcom is doing just that, according to Dow. Building on its strength in token-ring networking, the company unveiled in June Version 4.0 of its Microcom LAN Bridge, a source routing 16/4M bit/sec token-ring bridge.

While Dow declined to provide specifics on other new internetworking products on tap, he said Microcom plans to add routing

(continued on page 15)

INDUSTRY BRIEFS

Novell reports revenue, earnings increases. Novell, Inc. last week posted revenue of $168 million for its third fiscal quarter ended July 27, up 28% from revenue of $131.1 million for the third quarter of fiscal 1990.

Earnings for the third quarter grew 65% to $43 million from $26.1 million posted for the same period last year.

According to Raymond Noorda, Novell's chairman, president and chief executive officer, the third-quarter financials were buoyed by strong international revenue. International revenue grew to $77.7 million, up 46% from $56.2 million in revenue posted for the second quarter.

NCR finds ISDN mate. NCR Corp. recently said it has hooked up with BellSouth Information Systems, which will sell NCR's Integrated Services Digital Network terminal adapters with BellSouth's Origin software. Origin, which operates on a variety of computer platforms including Digital Equipment Corp. VAX and IBM workstations, interfaces with a private branch exchange or other switching device to simultaneously access a customer file on a computer screen at the moment a customer's call reaches a service agent. Use of the ISDN terminal adapters lets voice and data communications be handled through a single ISDN line. A BellSouth spokeswoman said the company is installing Origin in its service centers.

Short list of GOSIP-compliant products

Conformance-tested products entered in the NIST registry:

Product	Registered	Manufacturer
Local Area Controller Subsystem 8802/2, 8802/3, DPS6000/HVS6 Release 2	April 1	Bull HN Information Systems, Inc.
AT&T X.25 Network Interface Product Release 2.0	April 9	AT&T Computer Systems
HP OSI Transport Services/9000 Series 800 Version C.02.00	May 28	Hewlett-Packard Co.
IBM X.25 Network Control Program Packet-Switching Interface Version 3 Release 4	July 10	IBM
HP X.400/9000 P/N HP32032A Version C.02.00	Aug. 19	HP

GRAPHIC BY SUSAN J. CHAMPENY

SOURCE: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MD.

Few products make it to GOSIP registry

Despite establishment nearly a year ago, NIST registry lists only five GOSIP-compliant products.

By Ellen Messmer
Washington Correspondent

GAITHERSBURG, Md. — Despite its establishment almost 10 months ago, a federal conformance test registry for Government Open Systems Interconnection Profile (GOSIP) products is nearly empty.

Since November, the National Institute of Standards and Technology (NIST) has accredited nearly 10 laboratories — some of them first-party labs run by vendors themselves — where products are submitted to undergo a battery of OSI conformance tests.

To date, however, only five products have passed the conformance tests established by the NIST Program for U.S. GOSIP Testing, earning the right to be listed in the NIST registry. Participants say the testing process is time-consuming and the test software needs tuning.

But the GOSIP product list appears destined to grow, as vendors voice their commitment to product testing.

Successful completion of the tests is needed to satisfy the government requirement for GOSIP compliance in products based on the X.400 Message Handling System, File Transfer, Access and Management (FTAM), X.25 packet-switching and other OSI protocols.

A Hewlett-Packard Co. X.400 messaging product, the X.400/9000 for the HP 9000 minicomputer, last week became the first such messaging system to pass conformance tests and be entered onto the NIST GOSIP registry (see graphic, this page).

HP's OSI Transport Services product was also the first to be approved for the transport-layer Connectionless Network Protocol and Transport Class 4.

Noticeably absent from the list today are products from Retix, a key supplier of OSI products to the government under several major contracts. Last week, Retix vowed to have its products, such as its X.400 software, on the list by the first quarter of next year.

Malcolm White, director of strategic account management at Retix, conceded that the company has been slow in seeking the necessary NIST approval for conformance testing. The company is now in the process of deciding whether to become an accredited lab itself or have its products tested by a third-party lab.

Jean-Philippe Favreau, head of the NIST GOSIP program, said the small number of entries in the registry illustrates the fledgling nature of the market and validates the need for testing.

"It's a confirmation that testing was necessary because the products weren't ready," he said. "Many vendors have claimed compliance to GOSIP in the press, but in my mind, many claims are not substantiated — at least not formally."

Murali Subbarao, HP's conformance center Manager, confirmed that the roughly 1,500 separate conformance tests performed on the HP products did uncover a handful of flaws that the company later rectified.

Subbarao emphasized it takes time to thoroughly test products. Even HP's FTAM product, which

(continued on page 15)

BUSINESS TELEPHONE SYSTEMS

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#1 Mitel has just been rated Number 1 in overall customer satisfaction among the Top 10 PBX manufacturers.

Dataquest Inc.,* a Dun and Bradstreet company, surveyed over 1,000 PBX users and, not surprisingly, Mitel scored the highest overall rating.

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*DATAQUEST INC. (A Dun and Bradstreet Company), Score Report, Customer Satisfaction – PBX Systems; June 1, 1991

Worth Noting

The U.S. market for radio pagers will climb from about $1.5 billion in 1991 to $2.1 billion in 1996, when the number of people using pagers will reach 23 million, according to a recent report from Frost & Sullivan, Inc., a New York research firm.

Carrier Watch

The Ohio Bell Telephone Co. recently announced plans to spend $1.2 million to build a 20-mile fiber-optic ring that will afford users in the Akron, Ohio, business district greater service reliability. The ring will start at Ohio Bell's 50 Bowery St. switching center, circle through downtown Akron's business district and terminate at the same central office.

The design offers greater reliability because traffic can flow in either direction. In the event of a fiber cut, the fiber automatically reverses direction to prevent a significant disruption in service.

The Akron fiber ring is the latest project in Ohio Bell's fiber deployment effort. The Bell operating company expects to have 60,000 miles of fiber-optic cable deployed by year end, with more than 2,000 miles throughout Akron and Summit counties.

US West Communications, Inc. last week announced plans to offer caller name and number identification line blocking as part of its Boise, Idaho, Custom Local Area Signaling Services market trial.

The new capability will let customers permanently block their name and number from being displayed when they place calls to subscribers with caller ID units. All users will pay either a onetime $20 charge or a monthly charge ($2.50 for residential users and $3 for businesses).

The Travelers employs ACD tool to support home agents

User brands four-month beta test a success.

By Bob Wallace
Senior Editor

HAMDEN, Conn. — The Travelers Corp. recently concluded a successful beta test of AT&T software that enables automatic call distributors (ACD) to route calls to agents working at home.

The Travelers said the Home Agent software, which it beta-tested at a call center here for four months, will reduce agent turnover by enabling the company to offer the option of working from home.

"The Home Agent software worked perfectly and without technical problems," said Gus Bender, a second vice-president with The Travelers' telecommunications division. "It performed as billed."

Although The Travelers already lets agents use computers to process paper claims from home, it was not until the company began using Home Agent that its call center could actually route incoming customer calls to agents working at home.

Home Agent runs on AT&T's Conversant Voice Information System voice response unit and instructs The Travelers' AT&T Definity Generic 1, configured as an ACD, to route calls to these remote agents.

A home agent calls into the Conversant or the Definity Generic 1, which passes the call to the voice processing system. The system links the caller to the private branch exchange and notifies the switch that the agent is ready to receive calls.

Incoming customer calls are then switched to the PBX port holding the line to the remote agent; the agent's line simply appears as another agent position. The agents use microcomputers to dial in to the call center's host via a separate line to access customer profiles.

Performance statistics for home agents, including the number of calls handled and call duration, are recorded by the same AT&T call management system used to monitor performance of call center-based agents.

In The Travelers' four-month beta test, an AT&T Definity Generic 1 routed calls to call center agents and to 12 agents working at home. Pleased with the performance of the program, The Travelers decided to let the agents continue to work at home.

"The top benefit is we can retain agents that we would other-

(continued on page 11)

WASHINGTON UPDATE

BY ANITA TAFF

CompuServe challenges ruling. CompuServe, Inc., an information services provider based in Columbus, Ohio, last week appealed U.S. District Court Judge Harold Greene's decision to lift the ban prohibiting the regional Bell holding companies from offering information services. The firm did not give the legal grounds upon which it intends to challenge the ruling. MCI Communications Corp. and the American Newspaper Publishers Association have also appealed the decision.

Greene lifted the information services ban — which was established by the Modified Final Judgment — last month after a higher court had ruled Greene erred in an earlier decision in which he kept the ban in place. Greene said in his order last month that he felt the higher court's ruling set out such narrow guidelines for the review of his earlier decision that he had no choice but to allow the RBHCs to offer information services.

However, anticipating the controversy that would follow, Greene issued a stay of his order until all appeals are settled. Attorneys estimate this could take as long as two years.

AT&T wants price increase. AT&T told the Federal Communications Commission last week that it wants to increase the cost of directory assistance calls for business and residential users from 60 cents to 65 cents. The new rate, which will take effect Sept. 1 if approved by the FCC, will apply to all interstate directory assistance calls as well as directory assistance calls to Canada and the 809 area code in the Caribbean.

Use of equal access

Number of resellers and carriers using equal access in:

Date	45 or more states	25 to 44 states	12 to 24 states	4 to 11 states	Total (in 4 or more states)
1986	2	6	1	14	23
1987	3	5	1	18	27
1988	3	5	4	12	24
1989	4	6	3	24	37
1990	7	5	8	37	57
1991	6	2	14	38	60

Figures are for March of each year.

SOURCE: FEDERAL COMMUNICATIONS COMMISSION, WASHINGTON, D.C.

GRAPHIC BY SUSAN J. CHAMPENY

Users slam AT&T on access charge issue

Carrier's failure to pass along cost savings from reductions has major private-line users up in arms.

By Anita Taff
Washington Bureau Chief

WASHINGTON, D.C. — Major users of AT&T private lines say they aren't getting their fair share of rate reductions as AT&T's special access costs drop.

The Ad Hoc Telecommunications Users Committee charged in a recent filing with the Federal Communications Commission that AT&T is breaking the law by failing to pass along to customers the savings it gets from reductions in access charges paid to the regional Bell holding companies and other local carriers.

According to Charles Hunter, counsel for Ad Hoc, access charges account for about 50% of the cost of a long-distance call.

"Millions of customers are currently being overcharged as a result of AT&T's persistent failure to satisfy its [private-line] flow-through obligations," the group said in its filing. "AT&T's ongoing failure to effect such flow-throughs is unlawful and contrary to commission rules and policies."

In a formal response to the FCC, AT&T strongly disputed Ad Hoc's contention that it is required to pass on access charge savings. Although AT&T acknowledged that the FCC has ordered it to lower rates in response to access charge reductions, those orders are "in no way purported to establish a general flow-through requirement . . ." AT&T said.

Ad Hoc said that until mid-1990, AT&T was passing along savings from reduced access charges. "Thereafter, however, AT&T, inexplicably ceased to pass on to [private-line] customers any further cost savings realized as a result of [local exchange carrier] rate charges," the group said.

Hunter said customer losses vary by state and carrier. He estimates the total losses to be in the tens of millions of dollars and possibly as much as $100 million. The group wants the FCC to order AT&T to pass back access savings to customers in the form of reduced rates.

> "AT&T's failure to effect flow-throughs is unlawful and contrary to commission rules."
>
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AT&T's rates for private-line services are actually a composite of AT&T's charges and access charges paid to the RBHCs. As such, Ad Hoc contends that AT&T should reduce its private-line rates on a dollar-for-dollar basis every time local exchange carriers lower their special access charges.

The reason that AT&T has been able to withhold access charge savings from users, according to the group, is that Tariff 11, from which AT&T sells private-line services, gets different regulatory treatment than other AT&T business services.

When the FCC implemented price cap regulation for AT&T in 1989, the agency decided to exclude Tariff 11 from the new plan. Price caps are designed to

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Grumman tags US Sprint for nationwide digital net

T-1 backbone to reduce voice, data traffic costs.

By Bob Wallace
Senior Editor

BETHPAGE, N.Y. — After analyzing its network needs for two years and evaluating proposals from 14 carriers, Grumman Corp. recently selected US Sprint Communications Co. to build a nationwide digital backbone net that is expected to cut the company's communications costs by 30% to 40% a year.

US Sprint will construct a nine-node T-1 backbone with tail circuits fanning out to smaller sites that will carry voice and data traffic between Grumman headquarters here and 119 other sites across the country.

The net will replace a myriad of analog and digital point-to-point and point-to-multipoint private lines currently used to link the sites.

"[US Sprint] proposed the most efficient, flexible and cost-effective network configuration," said Martin Keller, Grumman Data Systems Division's network manager. "[The carrier best] met [Grumman's] fiscal, technical and network management requirements."

The net will carry the lion's share of the company's voice traffic between its U.S. sites, but some traffic will be handled by a US Sprint Virtual Private Network.

The network will also enable design engineers throughout the country to more easily send and receive designs from Grumman's geographically dispersed manufacturing facilities, according to Keller. Employees in administrative offices will be able to quickly access mainframe-based business applications at the company's New York data center, as well.

"What we had done in the past was to go with the most cost-effective carrier for each communications requirement," he said. "We had lines from everyone, which made the [system] difficult to manage."

Keller said the collection of facilities only partially resembled a network.

"I wouldn't call it a bunch of lines, but it wasn't a wideband network," he said. "We had the capability to get from wherever we were to wherever we wanted to go, but it wasn't always a direct path."

Grumman used network services provided by the Big Three and several other national carriers, Keller said.

> "We wanted to stay with a national carrier because we felt they could better handle our requirements," Keller said.
>
> ▲▲▲

In 1989, Grumman began analyzing its network requirements and projected them for the next five years. The company also conducted an extensive analysis of its current and future traffic patterns.

"We were looking for a network that would [give] us flexibility as our voice and data needs grew," Keller said.

After completing the evaluation of its requirements, Grumman issued a request for proposal for an all-digital network that would serve company locations scattered across the country. The company received proposals from more than a dozen carriers, but narrowed the field to a handful that included AT&T and US Sprint. "We wanted to stay with a national carrier because we felt they could handle our requirements better than a smaller regional player," Keller said.

After evaluating network proposals and the cost of each, including a Tariff 12 bid by AT&T, Grumman selected US Sprint.

"US Sprint was the lowest bidder, and their proposal promised the greatest savings for us," said a Grumman source who requested anonymity.

But Grumman's network optimization efforts won't stop now that it has a new network. "We continuously perform cost-optimization on our network," Keller said. "It's an ongoing battle, but it's one we have to fight if we're to drive down the cost of the network."

Major users slam AT&T

continued from page 9

give carriers incentives to lower costs, but the agency said that because the vast bulk of the costs of providing Tariff 11 service are [local exchange carrier] special access rates, AT&T has little ability to change its rates and therefore price caps offer little incentive to lower costs.

Under the previous rate-of-return regulation, the agency did not have a formal rule requiring flow-through of access charge savings.

But the Ad Hoc Telecommunications Users Committee contends that the FCC did order such savings be passed along each time access rates were cut by the local carriers.

The FCC formalized this practice under price caps, by including a provision in the formula that adjusts rates to reflect reduced access charges, according to the group.

"If Tariff 11 had been placed under price cap regulation, the flow-through requirement would have been codified and, hence, undeniable," the group said. "For AT&T to argue that Tariff 11 should be excluded from price

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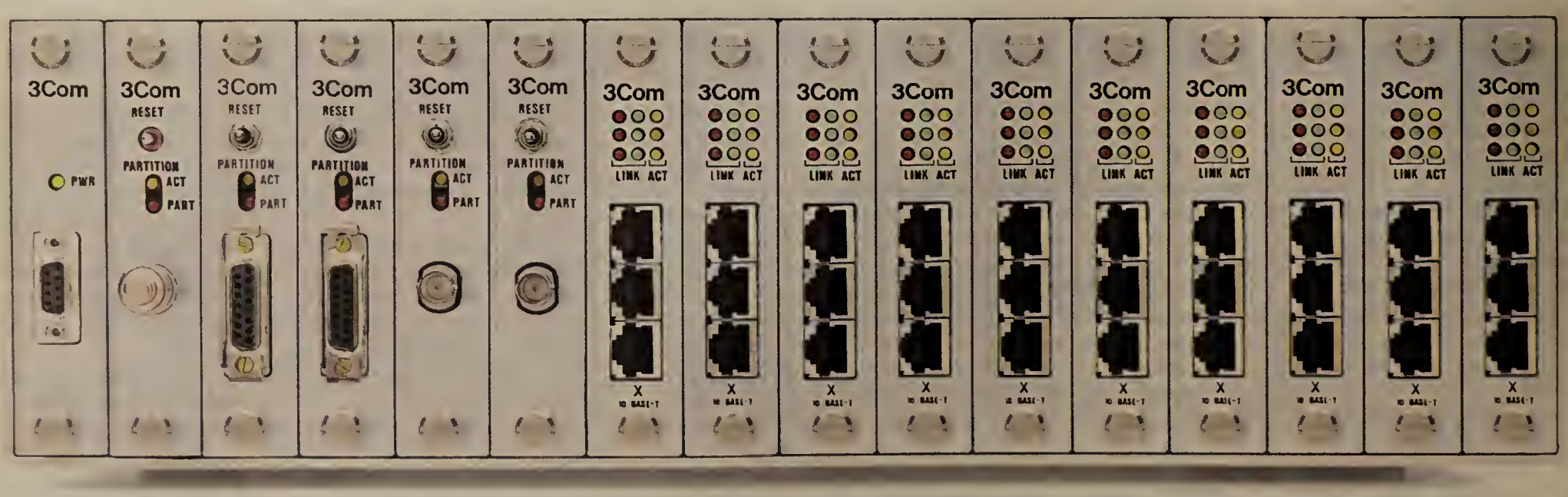

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cap regulation because of its flow-through nature, and then to fail to effect the flow-throughs of special access rate reductions is, even viewed charitably, disingenuous," the group told the FCC.

But AT&T disputes both Ad Hoc's claim that price cap regulation would ensure dollar-for-dollar reductions and that it is required to flow through savings from drops in access charges.

"Access rate reductions do not have to be flowed through on a . . . service-by-service basis under price caps. Instead, an access cost reduction serves only to change the cap for the entire basket of services, with any resulting reductions to be allocated to particular services by AT&T," the carrier said in an FCC filing.

AT&T said a rule requiring dollar-for-dollar flow-through is unneccesary. Customers can purchase special access directly from the local carrier, rather than through Tariff 11, or from alternative providers of access.

"Ad Hoc ignores the difference between concluding that a tariff, as a practical matter, flows through underlying access costs and imposing a requirement that a tariff flow through every single change in special access rates," AT&T said in its filing.

AT&T draws fire for net management service deals

By Anita Taff
Washington Bureau Chief

WASHINGTON, D.C. — Rivals cried foul last week over a new AT&T proposal to give large users discounts on unregulated network management services based on their usage levels of certain regulated telephone services.

MCI Communications Corp., US Sprint Communications Co. and the Independent Data Communications Manufacturers Association, Inc. (IDCMA) filed protests against AT&T's proposed offering, dubbed Multiple Tariffed Services Term Option (MTSTO).

The opponents claim that such a deal is illegal because it singles some customers out for special treatment, allows AT&T to leverage its dominant position in some services and appears to cross-subsidize unregulated services with money from regulated offerings.

MTSTO is targeted at customers spending between $6 million and $12 million annually on AT&T's outbound switched and private-line services. Customers who are using or plan to purchase AT&T's Accumaster Management Service can sign up for a three-year term of MTSTO and receive a discount on the management service based on their phone usage.

AT&T rolled out its Accumaster Management Service in January 1989. Under the plan, the carrier supplies experienced network management personnel to users in order to help with tasks such as placing and tracking orders, monitoring and correcting network faults, and analyzing network performance. These network staffers can work either at the customer site or at an AT&T site.

AT&T will include usage from a wide range of services in the calculation for customer discounts, including Software-Defined Network, Megacom, International Message Toll Service, Accunet, Skynet and Digital Data Services.

Customers who spend at least $500,000 monthly on a combination of these services will receive a $26,000 monthly credit on Accumaster Management Service charges. Customers spending a minimum of $666,000 per month will receive a discount of $35,000, and those users spending at least $833,000 per month will get a $43,000 discount.

MCI said that AT&T's proposed deal is illegal because it discriminates among users.

"AT&T is proposing to provide varying credits against contract service charges to customers who commit to and satisfy MTSTO service requirements, while denying those credits to customers, similarly situated, who would choose not to take AT&T's Accumaster Management Service," MCI said in a filing last week.

MCI also said that MTSTO illegally ties an unregulated service to a regulated offering, comparing it to an AT&T deal that the Federal Communications Commission found unlawful in 1989. AT&T proposed offering various pieces of net equipment from its unregulated unit free of charge to customers who subscribed to certain regulated phone services.

MCI and US Sprint both complained that the MTSTO deal is also illegal because it proposes to offer credits based on usage of several services in which AT&T holds a dominant position: international switched voice, domestic switched voice and analog private lines.

IDCMA expressed fears that the Accumaster Management Service may include provision of equipment, which would violate FCC rules that prohibit AT&T from bundling regulated service with equipment.

Firm uses ACD for home agents

continued from page 9

wise have lost," Bender said. "We have a number of valuable agents who have proven themselves in the office but have to stay at home to take care of a child or an elderly parent. We don't want to lose these employees."

The cost of replacing lost agents is high. "When we lose an agent, we lose the time and effort we spent training the individual and the overtime we have to pay other agents to handle the calls," he said. "It's a huge loss."

The Travelers has not yet decided in which of its call centers it will deploy the software. The insurer has 60 call centers equipped with Definity 1 or 2 PBXs configured as ACDs.

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UDS offers more choices, more features than any other modem builder

UDS, acknowledged by leading trade magazines and independent research organizations as the world's premier supplier of V.32 modems, offers more variations on the V.32 theme than any other manufacturer.

Beyond basic V.32 conformity lies a myriad of features and options. Among the user options available are:

PACKAGING—Board-level IBM plug-ins, standalone packages or central site rack-mountable cards.

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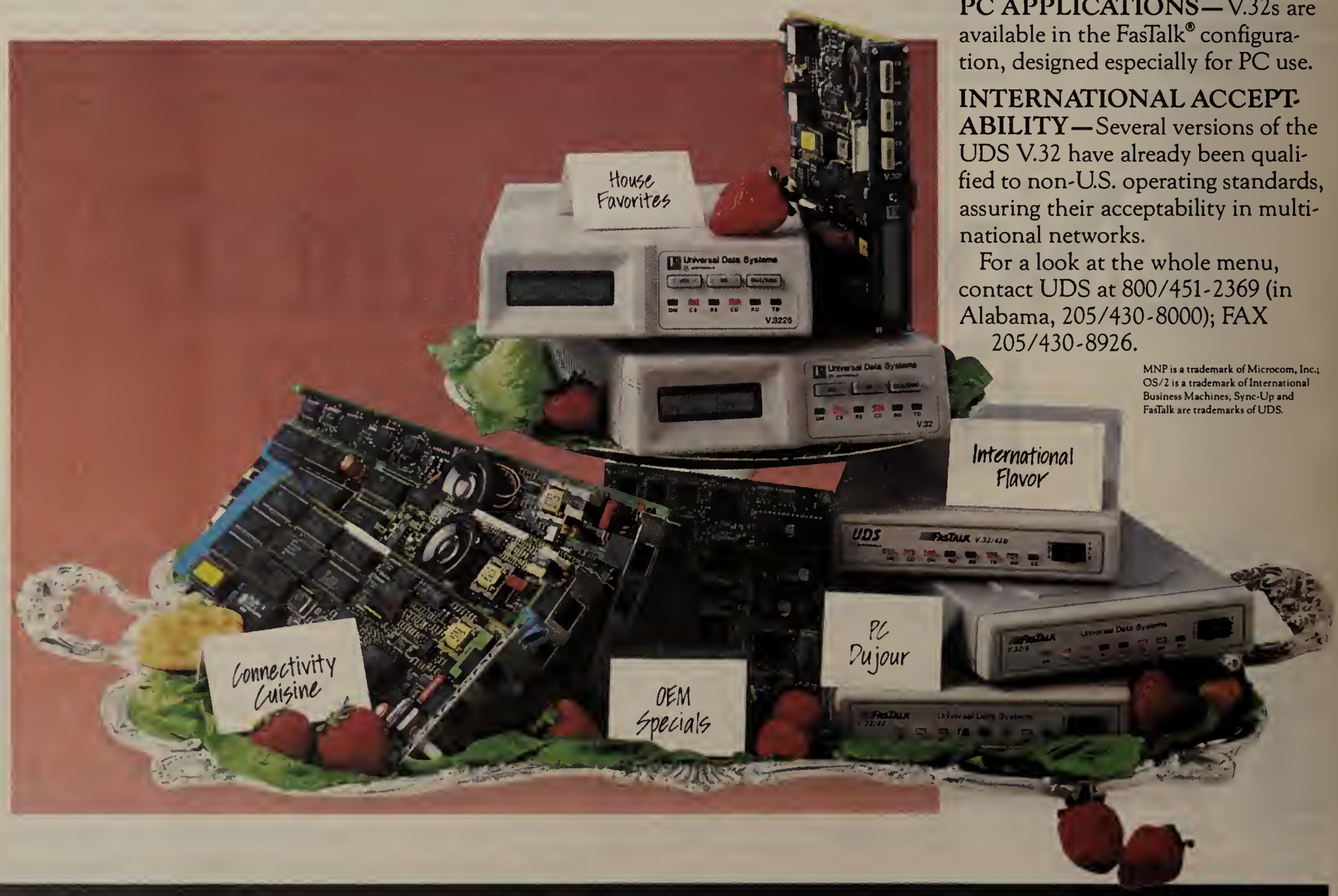
CONNECTIVITY—Sync-Up™ board-level versions of V.32s are available for various combinations of BSC, SNA and OS/2 host-to-remote communication for EDI, X.25, BSC, SNA and LU6.2 applications.

PC APPLICATIONS—V.32s are available in the FasTalk® configuration, designed especially for PC use.

INTERNATIONAL ACCEPTABILITY—Several versions of the UDS V.32 have already been qualified to non-U.S. operating standards, assuring their acceptability in multinational networks.

For a look at the whole menu, contact UDS at 800/451-2369 (in Alabama, 205/430-8000); FAX 205/430-8926.



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TOKEN RING INTERNETWORKING

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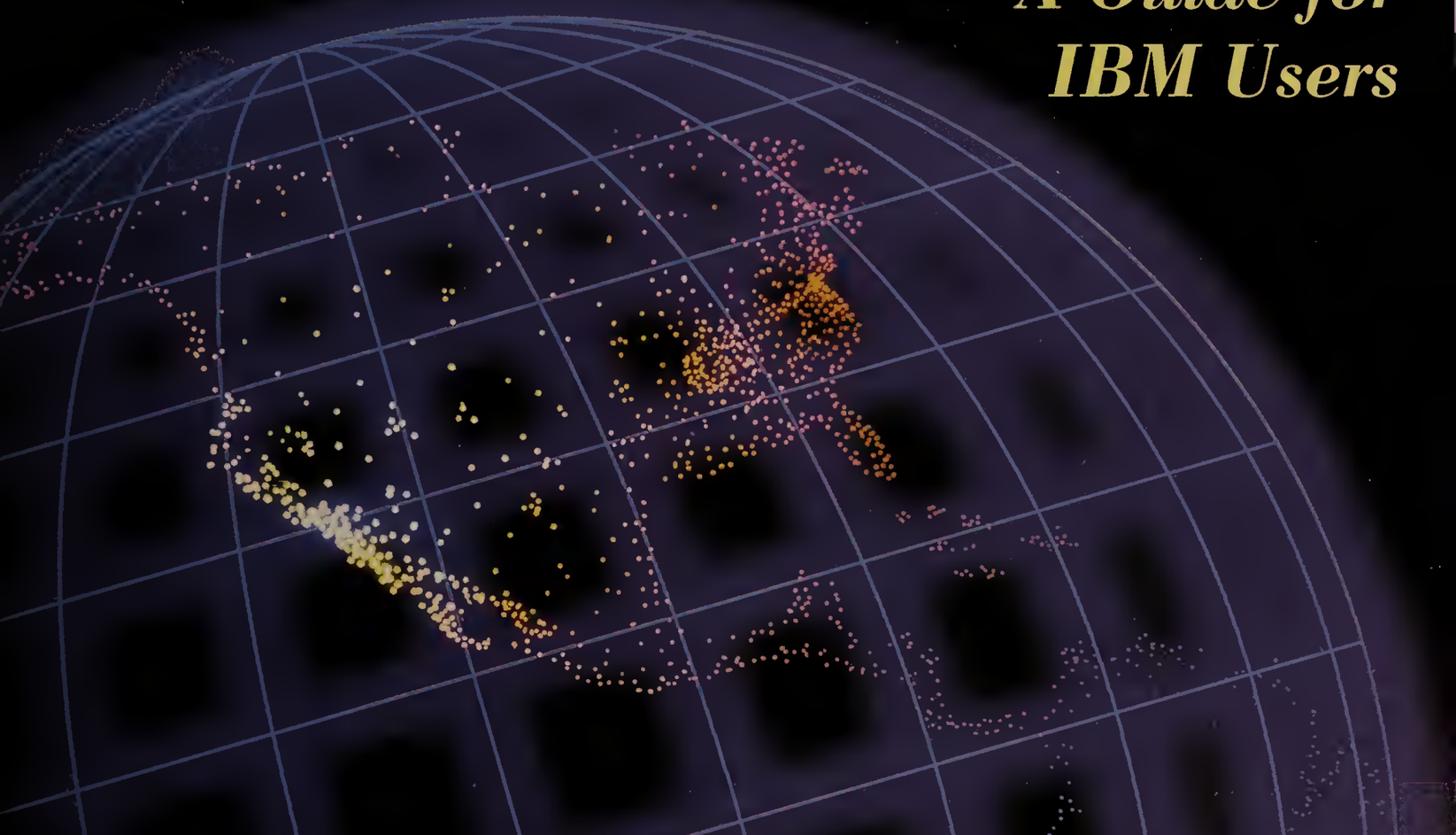
A Guide for IBM Users



An Executive Introduction to Corporate Networking

Building "Enterprise Networks"

IBM's Internetwork Strategy: Pros and Cons

Disaster Recovery Specialists' Network for the '90s

Protocol Independent Router: Internetworking Tool of Choice

CORPORATE NETWORKING: YOUR COMPETITIVE EDGE

An Executive Introduction

In today's competitive business world where the margin between success and failure is shrinking rapidly, why does one company succeed where another one fails?

How did Federal Express become *the* overnight carrier of choice? Why is WordPerfect the most popular wordprocessing package in the world? What makes Nordstrom customers so loyal?

The answer is information. To win and keep customers, these successful companies, and thousands like them, surround their products and services with information their customers need and want.

Federal Express tells its customers where their packages are at all times. WordPerfect offers excellent free technical support. Nordstrom provides free personalized service.

By complementing their products and services with information, information their customers will pay good money for, these successful businesses develop name recognition and customer loyalty. The information may take the form of technical support or personal service, but it is still information. And it still provides the margin between success and failure.

By exploiting information — all kinds of business information, including mailing lists, customer preferences, research statistics — successful companies create new profit-generating endeavors. They turn information into money.

Getting the Competitive Edge

To exploit information to its fullest, you must have it at your fingertips, in the right form, when you need it, no matter where you are.

If you are a salesperson in Los Angeles, you should be able to get the latest

product development reports from engineering in Palo Alto so you can keep your customers up to date.

If you are a bank manager in charge of mortgage approvals, you should have the latest information on your applicants, their credit ratings, real estate trends, zoning regulations, and interest rates.

Chances are, no matter what you do, you work with information. And the more you know, the more you sell. And the faster you know, the faster you sell.

The question is: How do you get information as fast as you need it, in the form you need it, no matter where you are?

The answer: With a corporate network.

Corporate networks are platforms for the exploitation of information. They make gathering, manipulating and distributing information easier and faster. And they change what you can do with that information.

Five ways corporate networks improve a company's competitive edge.

1. Instantaneous Communication. Corporate networks move information at the speed of light. And they handle virtually any type of information, including text, graphics, and scanned images.

2. Single Point of Access. Corporate networks give users access to all corporate information and network services from one place, or any place.

3. Control Corporate Info Resources. By uniting an enterprise's information resources, corporate networks centralize management so corporate executives may control and exploit all their company's information.

4. Access to New Markets. A company with a corporate network has more information and can do more with it, including finding new ways to sell it.

5. Mission-Critical Applications. With a corporate network, an enterprise can employ the myriad mission-critical applications available now and in the future. These applications enhance every aspect of the way we do business — from sophisticated cost accounting to powerful sales management to computer aided design and manufacturing.

New Computing Order

In the 1980s, American business discovered the benefits of networking. But networking was primarily local, limited to a single department.

In the 1990s, companies are discovering they reap even greater benefits by extending local connectivity to the entire corporation. They connect local networks together and tie these to remote networks in other sites. The result is a corporate network that contains the computing resources of the entire corporation and gives the same access to those resources no matter where users sit — in New York or New Delhi.

Corporate networks do more than tie computers together. Indeed, corporate networks are far more than the simple sum of their parts. To see why, read on.

THIS SPECIAL SUPPLEMENT

This special educational supplement is brought to you by **CrossComm Corporation**, a leading supplier of Token Ring internetworking equipment. CrossComm's ILAN intelligent routing device offers a modular four-port architecture that connects virtually any combination of local and wide-area networks. It supports Token Ring and Ethernet LANs as well as T-1, X.25, 56kbps and other WANs, all with plug-and-play simplicity. **CrossComm Corporation** is located at *140-C Locke Drive, Marlboro, MA 01752. 508-481-4060 or 1-800-388-1200.*

BUILDING ENTERPRISE NETWORKS

A Practical Guide to Internetwork Fundamentals

The basic building block of a corporate internetwork is the local area network (LAN). The LAN provides the basic connectivity between computer devices in the same local area, such as an office or department. An internetwork is a network of LANs. Strictly speaking, two connected LANs make an internetwork. But since LANs can be interconnected in a variety of ways, it is useful to distinguish two types of internetworks — facility-wide networks and enterprise networks.

When several LANs in one building, factory, or campus are connected, the result is a facility-wide network. When LANs are connected over large distances — across town, across the globe — the result is an enterprise network. The basic distinction is that enterprise networks usually contain some type of remote link, such as the telephone system or a public data network, between at least some of the LANs in the internetwork.

Given the fact that computer technology has developed and been adopted in heterogeneous fashion, an internetwork of any size is bound to have many types of devices and even many types of LANs. It is this heterogeneity that presents the major problem in building corporate internetworks. Computer vendors simply did not forsee the importance of networking. And they were even less cognizant of internetworking. Fortunately, there are solutions.

To see how corporate internetworks are built, we go back to the basic building blocks — LANs. Then we progress through facility-wide and enterprise networks.

LAN Fundamentals

LANs carry data in much the same way the telephone network carries your voice. But there are some significant differences. First, LANs are both hardware and software. The LAN hardware includes printed circuit boards (adapters) and cabling. The adapters connect computers to the cabling. LAN software, which is the brains of the LAN, runs in the

computers and on the adapters.

Second, whereas your voice moves continuously, one word at a time, across the phone line, data moves across LANs in packets. Before it is sent, data is broken into distinct packets. Special information is added to each packet to aid in transmission. First, each packet contains a source address which identifies the computer *from* which the packet is being sent. And second, it contains the destination address of the computer *to* which the packet is being sent. In addition, other information may be added to the packet, but that need not concern us here.

The LAN uses the addressing information in each packet to get it from computer to computer. That is, the hardware and software that make up the LAN understand and use the information in each packet.

Each type of LAN has its own software for sending packets. That software is called a LAN operating system. Examples are Novell NetWare, IBM LAN Server, and Banyan Vines. Each type of LAN also has its own set of rules for sending and receiving data. That set of rules is called a protocol. Examples are IBM DLC, SNA, TCP/IP and many more. Together, LAN operating systems and protocols define how information is exchanged between computer devices.

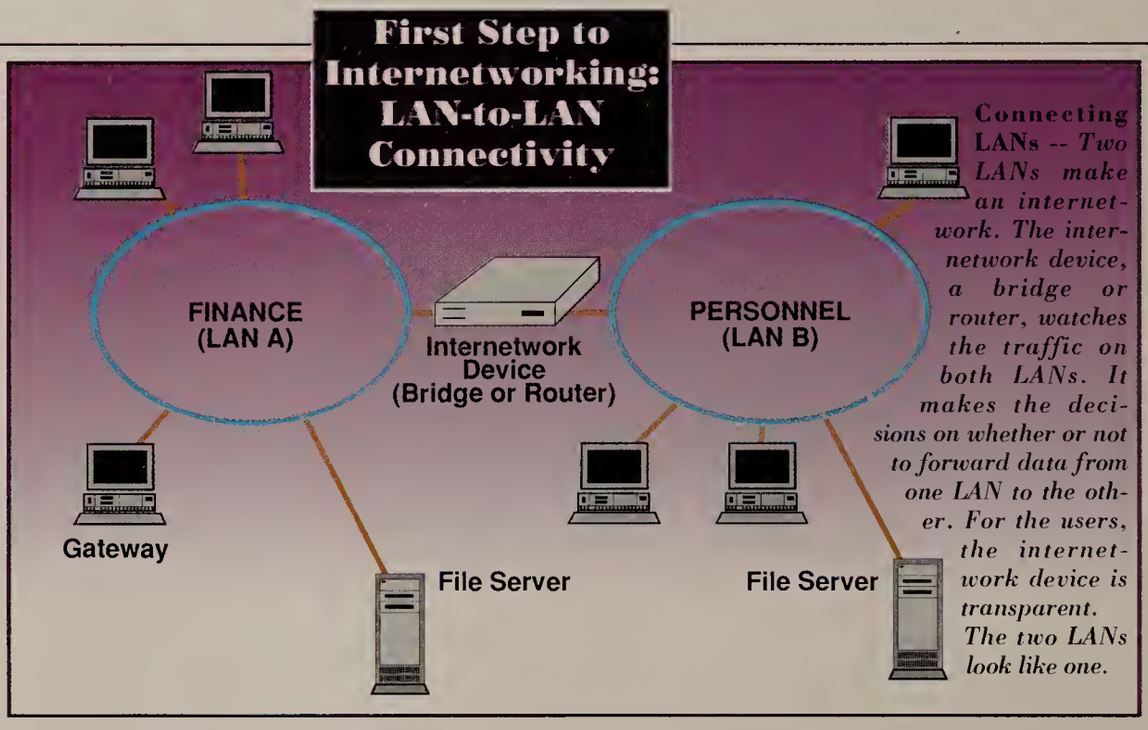
Connect two LANs: it's an internetwork. Connect a building: it's a facility-wide network. Connect your company: it's an enterprise network. Here's how it's done and what networking can do for your company.

Such things as how computers find themselves, how they begin to communicate, how they assure correct information delivery, how they recover from errors, and how communication ends are all defined by LAN operating systems and protocols. For simplicity, we will refer to both LAN operating system and protocol with the single term protocol.

Many protocols can exist on a single LAN. But devices that use different protocols cannot communicate over that LAN without special equipment. When two computers running different protocols, such as a PC running NetWare and an IBM mainframe, want to communicate over a LAN, a special computer, called a gateway, is needed. The gateway performs the function of a protocol translator. It translates the NetWare protocol into a protocol that the mainframe understands and vice versa.

LAN-to-LAN Connectivity

For many reasons, including size, location, performance, and reliability, the number of computers connected to a single LAN has an upper limit, usually between 20 and 50. Large corporations with thousands or tens of thousands of users obviously need more than one LAN. And these LANs must be connected together so computers on different LANs can talk to



each other. This is internetworking.

The simplest example of internetworking is the connection of two LANs with an intelligent device, such as a bridge, router, brouter, or similar equipment. The internetworking device is nothing more than a packet switch. It performs the function of a traffic cop. It monitors all the packets on LAN A and LAN B. If it detects a packet addressed to a computer on LAN B, it lets that packet through (forwards it), while stopping (filtering) all others. As a result, computers on the two LANs can send data to each other.

If two communicating devices on different LANs are running the same protocols, they will have no trouble talking. Otherwise they will need a gateway (on one of the LANs) to translate the incompatible protocols. In either case, the internetworking device between the two LANs must switch all the LAN protocols being used, otherwise the computers cannot send data packets to each other or to the gateway device.

Many LANs

With many LANs in the same facility (building or campus) a backbone network is often used for connecting all the LANs. A backbone is nothing more than a LAN (often a 16Mbps Token Ring) with a number of internetworking devices connected to it. Each internetworking device connects one or more LANs (subnetworks) to the backbone. LAN packets destined for computers on other subnetworks are switched from a subnetwork to the backbone by an internetworking device. The backbone acts as a data highway carrying LAN packets to other internetworking devices which select those LAN packets that are addressed to computers connected to their

WAN Services

Here is a brief description of several popular wide-area network services. These are the services used to make LAN-to-LAN connections over great distances. Most of these are provided by telecommunications or data communications companies. For example, the phone companies or Telenet.

Leased Line: A low speed telephone line that with the help of a modem can provide transmission speeds of up to 19.2kbps. A 1M-byte file transfer will take about 7 minutes using this service.

DDS: A 56Kbps link that is most commonly used for low speed connectivity between remote LANs. A 1M-byte file transfer will take approximately 150 seconds.

T-1: Operates at 1.54Mbps and is the most popular way to interconnect LANs. A 1M-byte file transfer takes less than 10 seconds.

X.25 Network: A packet switched network (private or public) used primarily internationally (because of its relatively low cost) or in connecting low capacity LANs. Because of overhead and low speed a 1M-byte file transfer may take several minutes.

Frame Relay: A new WAN technology that is analogous to X.25 except it provides much higher transmission speeds (in the range of 1 to 2Mbps). When available as a public network it will provide high speed bandwidth on demand which is particularly useful in LAN internetworking owing to the fact that LAN traffic is very bursty.

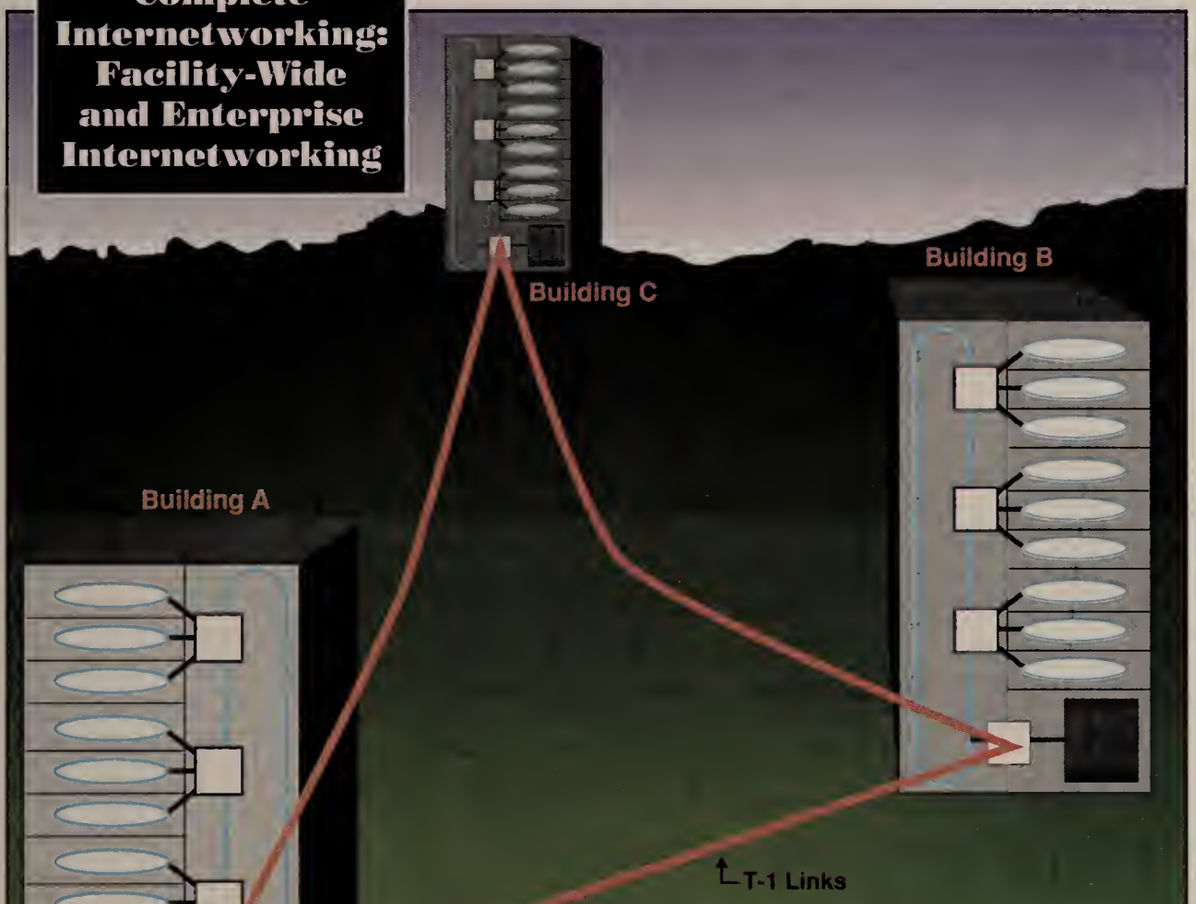
T-1 Network: A private corporate network that combines voice, data and LAN internetworking traffic over a common network of T1 links. The amount of bandwidth for LAN internetworking is user selectable and can range between 19.2kbps and 2Mbps.

own subnetworks and switch them accordingly.

Some internetworking devices support multiple subnetworks. That is, they switch traffic between the backbone and several subnetworks as well as between the several subnetworks themselves. In the latter case, the inter-subnetwork packets never get on the backbone which means less traffic on the backbone. And that leads to better performance.

It is a good idea to connect commonly accessed computers such as hosts, front end processors, gateways, certain file servers, or remote communication devices to the backbone for better accessibility by computers on the subnetworks.

Complete Internetworking: Facility-Wide and Enterprise Internetworking



Networking the Enterprise -- *The network in each building is a facility-wide internetwork. The internetworking devices shown in each building connect multiple floor LANs to a central backbone. This allows computers throughout each building to talk to each other and to the mainframe computer, shown in the basement. For users, the internetworking devices are transparent. The internetwork appears as one large LAN. In connecting each building, an enterprise network is created. In this case, the connection is a T-1 network, which may be private or owned by the telephone company. Other Wide-Area Networks could be used, including Frame Relay or 56kbps lines. The internetworking device that connects each building to the T-1 network performs essentially the same functions as the devices inside the buildings. They pass only that traffic destined for a different network. Again, to the users, the entire enterprise network appears to be one large LAN. Remote devices are accessed as if they were attached to a user's local LAN.*

Remote Connectivity

Internetworking devices also connect backbone or facility-wide networks to remote LANs using a variety of wide-area network connections. While the result is an enterprise network, the principles are similar. The internetworking device detects those packets destined for the remote LAN and forwards them. This time, however, they are put onto a wide-area network which carries them to the remote LAN (and another internetworking device).

The type of WAN connection used between LANs determines how fast LAN devices will communicate in an enterprise-wide network. Like the LANs themselves, the WAN, with all the internetworking devices connected to it, is nothing more than a packet switching network. Its role is to deliver LAN packets from a computer on one LAN to a computer on another LAN, regardless of LAN type or location.

In view of its strategic importance in the middle of all LAN-to-LAN communications, many corporations view the WAN as separate from the LANs it connects and give it much higher visibility in the corporate MIS.

Managing the Connectivity

So far, it should be clear that the key to internetworking is the internetworking devices that make the LAN-to-LAN connections. There are many types of internetworking devices — bridge, router, brouter, and others. While the differences can be confusing, it should be remembered that moving

Corporate Network Checklist

Putting together a corporate network is not easy. The technology can be complex and there is a bewildering array of products out there. Here is a checklist of general issues to keep in mind.

1. Internetwork Devices. The key to a successful corporate network lies in the devices used to connect local area networks (LANs) and wide-area networks (WANs). These devices have such names as bridges, routers, brouters, gateways, and intermodal processors. While they all work differently, they all perform essentially the same service: moving data from one network to another.

Some vendors would have you believe that how they work is more important than the results they deliver. Your corporate network has a job to perform. Make sure the internetworking device you choose does that job, no matter how it works.

2. Token Ring. Many large corporations use Token Ring networks. Unfortunately, most internetworking devices were originally developed and optimized for Ethernet. While these devices work well, especially in the scientific environment for which they were created, they do not perform well when connecting Token Ring networks in a business environment.

Internetworking devices tailored to Token Ring perform better and provide the powerful network management capabilities needed for large enterprise networks.

3. Protocols. Protocols are the languages used between communicating computers. Virtually all corporations use many different protocols, even those that buy their computers exclusively from IBM. Therefore, your corporate network must be able to handle multiple protocols.

There are several possible ways to handle multiple protocols on a corporate network. You can restrict the use of protocols to those your internetworking devices know. You can use internetworking devices that add new software each time a new protocol is used. Or you can use internetworking devices that work without regard to the protocols "spoken" by your network. These last internetwork devices are described as protocol independent.

4. IBM. Many large corporations already have an installed base of computers that use IBM's Systems Network Architecture (SNA) protocols. If your company has these protocols, your internetwork must support these protocols just as it supports other protocols. In this environment, protocol independence is crucial.

By combining SNA and other LAN traffic on the same internetwork, especially across WAN links, you will save money and time. You will have to pay for only one network instead of two and you will have to maintain only one network instead of two.

5. Network Management. Corporate networks should provide more than simple connectivity. They should provide a method for managing corporate network resources. You should be able to isolate problem segments of the network, prioritize certain communications, restrict access to only authorized users, and generally control the operation of the network. And you should be able to do so for the entire network from one location.

For most large corporations, the umbrella network management scheme of choice is IBM's NetView. But not all internetworking devices support IBM's NetView. Make sure your internetworking devices do.

packets from one LAN to another is a function of all internetworking devices, no matter what their type.

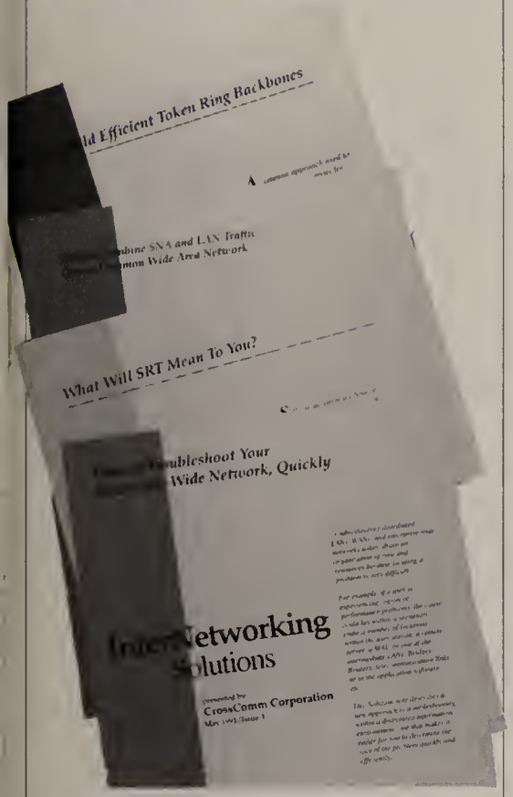
There has been much debate in the networking literature over the merits of bridges vs. routers vs. brouters. When putting a corporate internetwork together the main concern is building an internetwork that does what you want it to do. The merits of one type of internetworking device are not as important as whether that internetworking device does what you want it to do, whether or not it is a bridge, a router, or something else.

Probably the most important contribution an internetworking device can make is its ability to support network management, for managing the connectivity process is what makes the difference between an efficient internetwork and an inefficient one.

Such things as reliability, WAN efficiency, ability to select the best communication path, fault recovery, ability to control who can communicate with whom, detecting network problems, identifying faulty components, sensitivity to LAN protocols, ease of use, ease of expansion, ability to mix LAN protocols, maintenance, monitoring network usage, and capacity planning are some of the functions to look for in building an enterprise network.

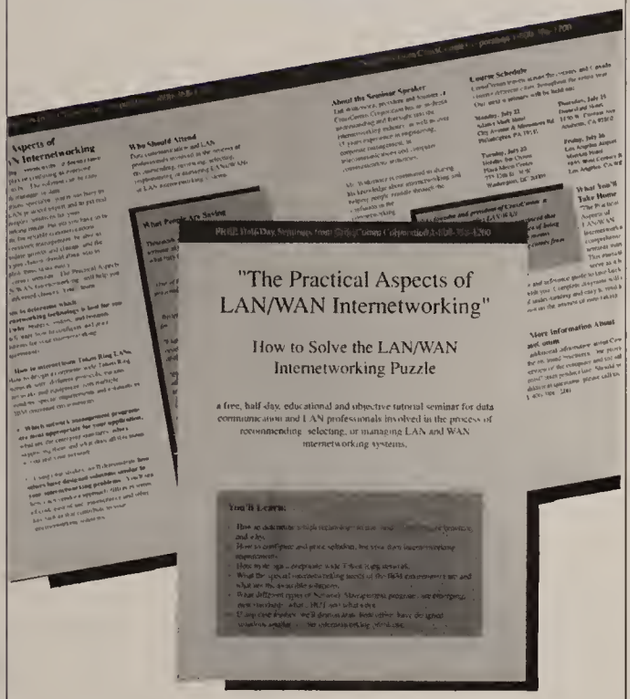
The larger the enterprise network the more important are these features. The bottom line is that the selection of internetworking devices should be done on the basis of the functions they provide. How they work inside is secondary.

Internetworking Solutions Newsletter



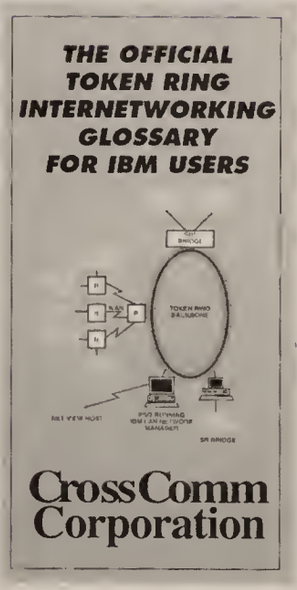
Published monthly, each issue shows how other network managers are solving internetworking problems. You'll find practical, no-nonsense information to help you and your organization.

Practical Aspects of LAN/WAN Internetworking Seminar



An easy-to-follow three-hour seminar on internetworking issues, technologies and case histories. You'll also learn selection criteria to help you decide which technology and vendors make the most sense for your application.

The Official Token Ring Internetworking Glossary For IBM Users



A comprehensive, easy-to-read, 64-page pocket-sized glossary of internetworking terms for the novice and expert alike. You'll keep it on your desk for handy reference.

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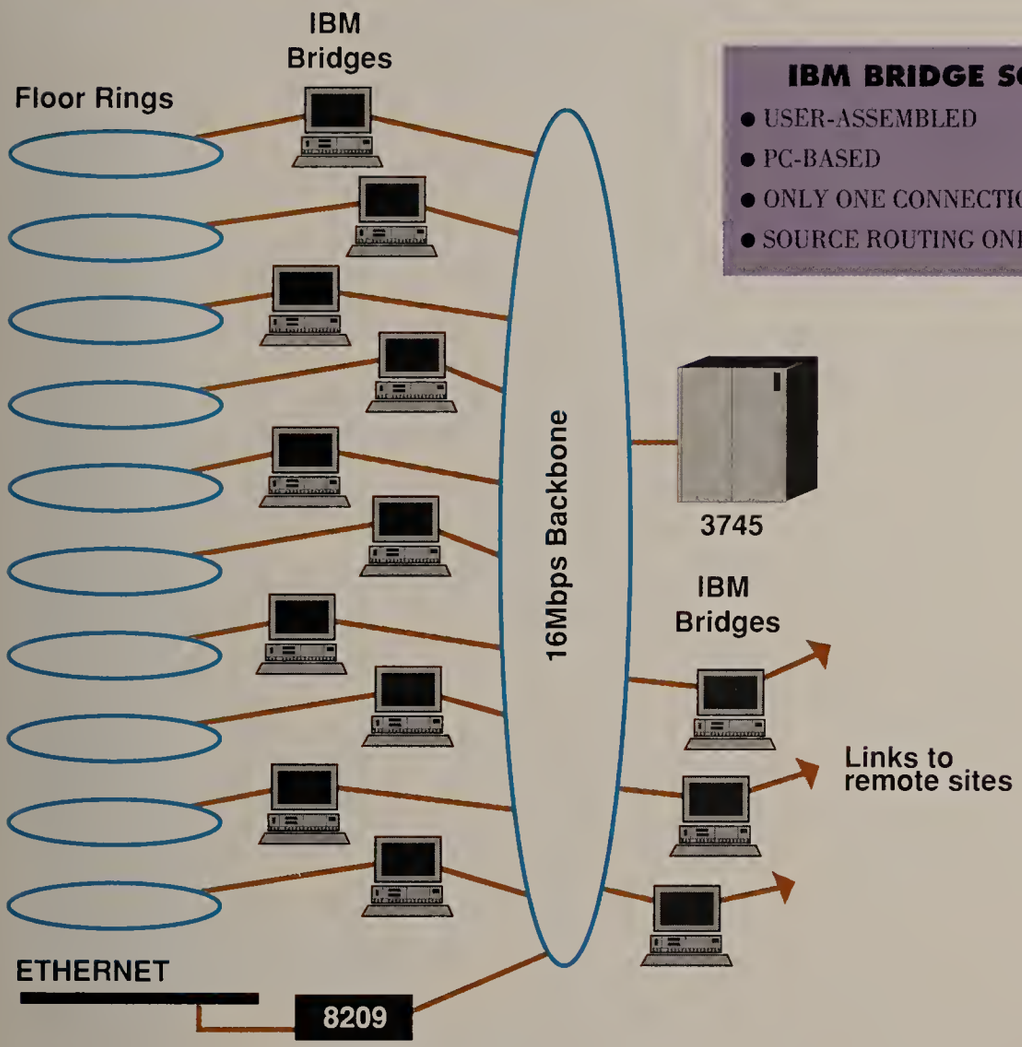
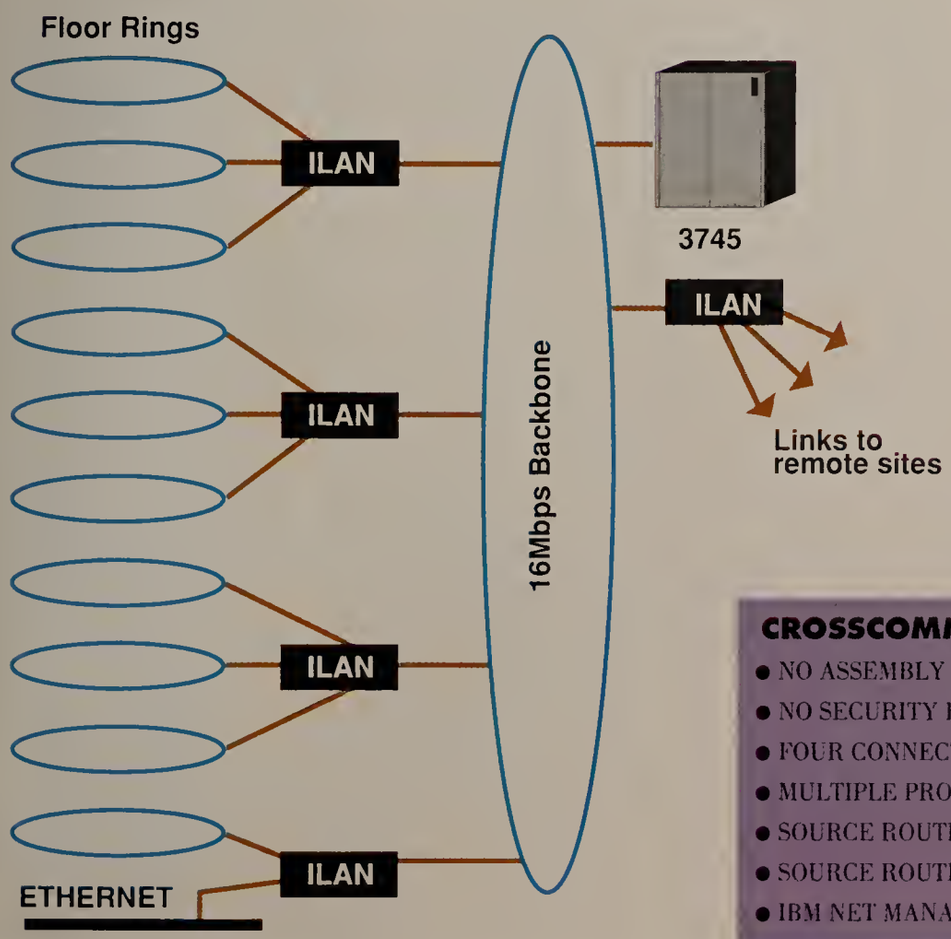
APPLICATION COMPARISON #1: FACILITY NETWORKING



IBM BRIDGE SOLUTION?

- USER-ASSEMBLED
- PC-BASED
- ONLY ONE CONNECTION PER BRIDGE
- SOURCE ROUTING ONLY

Compare Solutions — *CrossComm ILAN routing devices compare favorably with IBM Bridges. The IBM Bridge must be built using a PS/2, two Token Ring interface cards, and software. And since it has only one connection per unit, assembly must be done for every connection in the network. ILAN comes completely assembled, ready to plug and play. Since the IBM Bridge understands only source routed protocols, it will not pass any other protocols, thus eliminating their use on the network. ILAN adheres to the IBM-supported source routing transparent standard, so it will handle source routed protocols as well as many others. ILAN also supports IBM's network management scheme. It can be managed just like any other IBM Token Ring device using IBM's LAN Network Manager and NetView.*



CROSSCOMM ILAN SOLUTION

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- NO SECURITY RISK FROM KEYBOARD
- FOUR CONNECTIONS PER ILAN
- MULTIPLE PROTOCOL SUPPORT
- SOURCE ROUTING
- SOURCE ROUTING TRANSPARENT
- IBM NET MANAGEMENT SUPPORT

TOKEN RING ROUTING

What IBM Users Should Know About It

The linchpin of any corporate network is the internetworking device. It makes the LAN-to-LAN or LAN-to-WAN connection. In addition, it provides crucial network management functions. Your enterprise network cannot exist without it.

There are two basic types of internetworking devices: bridges and routers. Both are data packet switches, moving data from one network to another. Both work in similar ways. They examine each data packet that comes by and decide what to do with it: forward (pass it on to the next LAN) or filter (ignore it as not needing forwarding).

To connect two LANs so that packets from a computer on one LAN can get to a computer on the second LAN (regardless of the LAN type or location), a bridge or a router may be used. The two do exactly the same thing as far as connecting the two LANs is concerned — they move packets from one LAN to another.

But routers have two important advantages over bridges. First, they are more efficient than bridges. Second, they have the power to control and manage the connectivity process between networks.

Routers are more efficient than bridges for three reasons. First, if there is more than one path between two computers, routers can select the best way to get data from one computer to another. This selection can be done on the basis of price and/or performance.

Second, when one path between source and destination fails, routers can pick an alternate path. Thus, routers are able to maintain communication even when a network link goes down.

And third, routers can prevent unnecessary traffic from clogging wide-area network (WAN) links between LANs.

This also improves network performance and lowers network costs.

The network control and management features of routers also give them an advantage over bridges.

Routers can partition corporate networks in such a way as to control who can talk to whom. Entire departments or individual users can be restricted from certain network resources. In addition, routers can prioritize communications for certain computers or LAN protocols (the languages communicating computers speak).

Routers also aid in the detection and diagnosis of network problems. And some routers allow network managers to track network usage on a department or user basis.

Combined, the efficiency and network management advantages of routers make them a far better choice for building corporate networks than bridges. With routers, network managers have the ability to mold the network to its users' needs, hone its performance, and assure its maintenance. In a corporate network, with thousands of users, such ability is indispensable.

The internetworking device is the heart of the corporate network. This article introduces the technology and demonstrates why routers are the best internetworking devices for building today's large corporate networks.

Routers In Action

When computer A wants to send data to computer B, a router must answer the following two questions. First, where is computer B (which LAN)? And second, what is the best way to get there? These are the connectivity questions that are dealt with by all of today's routers. Once the router determines where computer B is located it uses a routing protocol to find the best path to send the LAN packets between the two computers.

There are two ways in which a router can determine the location of computer B. It can receive that information directly from computer A or it can learn it from other routers in the network. This is what makes routers fundamentally different.

Once the location of the destination computer has been found, all routers perform the same basic function: they deliver LAN packets from one LAN to another. While different vendors may still use different routing protocols, the industry trend is towards the Shortest Path First (SPF) protocol, which is

fast becoming a standard and which provides the best and most robust way to get packets from one LAN to another. (Open Shortest Path First (OSPF), which is used by some Transmission Control Protocol/Internet Protocol (TCP/IP) routers, is a subset of SPF.)

Protocol Dependent Routers

Routers used in Ethernet and TCP/IP applications that rely on communicating computers to determine to which LAN packets should be sent are called protocol dependent. These routers (offered by such vendors as cisco and Welfleet) must communicate with the computers in order to get the destination information and must understand all the LAN protocols running on the internetwork.

How do the computers know the network address of other computers? Different LAN protocols arrive at this information differently. For example, NetWare uses a complex discovery protocol in which all PCs and file servers participate. TCP/IP on the other hand relies on LAN users to know the 32-bit network addresses (IP address in TCP/IP parlance) of all the computers with which they wish to communicate. This is inconvenient since as people and computers move from one location to another it is easy to lose track of all the network address changes, particularly in a large network with thousands of computers.

A second problem with relying on the communicating computers for routing information is that some computers use protocols that contain no routing information and, therefore, cannot be routed. IBM NetBIOS, for example, employs a user friendly network and device naming convention (instead of 32-bit numbers, it uses such names as Fifth Floor LAN, Finance, and Harry's PC). This means that a protocol dependent router has no way of determining where and how to send such packets. In fact, protocol dependent routers act as bridges when it comes to IBM packets.

Some vendors of protocol dependent routers get around the "nonroutability" of some protocols by encapsulating SNA or NetBIOS packets into TCP/IP protocols. This adds a level of complexity that eliminates the user friendliness of IBM protocols. It also significantly reduces WAN utilization efficiency by adding the TCP/IP overhead which now must be sent with every SNA and NetBIOS packet. The trade off is hardly appetizing.

Protocol Independent Routers

Thanks to new routing technologies, however, a new class of routers is emerging: **protocol independent routers**. These routers do not rely on the communicating computers to tell them where to send the LAN packets. These routers discover that by themselves and without any assistance from the LAN users, computers, or network managers.

Each router monitors LAN packets on the LAN or LANs to which it is directly connected. As it monitors it learns which computers are located on those LANs. It builds an address table for all the LANs to which it is directly connected. Once done (which takes only a few seconds) each router shares its information with other routers in the network. Thus, each router knows where (on which network) every computer is located.

This is done automatically and without any assistance from the LAN user or any of the computers on the network. When computer A wants to send data to computer B, it just sends the packet addressed directly to B. The routers find the way independently. They take care of sending the packet from network to network.

There are several advantages to protocol independent routers.

1. They eliminate the human address administration required with some network protocols, such as TCP/IP.

2. They eliminate the hassle of administrating all the different networking rules used by LAN protocols.

3. They route so-called nonroutable packets, such as IBM NetBIOS, SNA and DEC LAT.

4. They accommodate any type of network protocol and route it using the best routing protocols on the market.

5. They can accommodate new protocols as they become available, without any upgrades needed.

Protocol independence increases the versatility and intelligence of routers. It facilitates the easy mixture of network protocols, which in turn opens wide the internetwork to the vast array of data communications applications.

Routing Management

The superiority of protocol independent routers becomes even more clear in the area of network management. Here is a partial list of essential network management features.

Mesh Network Support. To improve reliability and enhance performance, internetworks are often built in mesh fashion, with multiple WAN connections between LANs. In this environment, routers must be able to select the optimal path to provide for the fastest and/or least expensive method of data delivery.

Using a nonroutable (e.g. IBM) protocol can eliminate the advantages of a mesh network, since such protocols cannot be put on the best available path. The use of protocol independent routers takes care of this problem, since it will route nonroutable protocols. They deliver all LAN packets the best way, no matter what protocols are used.

Protocol dependent

routers cannot handle nonroutable protocols, so they bridge them. In the worst case, the packets may be put on every path, thereby hurting performance. Or, the packets may follow only one path, thereby eliminating the benefit of the mesh network.

Alternate Path Selection. This is part of mesh network support. In the event of a WAN link failure, a router must be able to dynamically pick the next best available path and do it quickly enough to prevent communication loss. Again, protocol dependent routers will not be able to offer alternate path selection for IBM protocols.

Access Control. Corporate-wide connectivity is important, but companies discover quickly that letting everyone send data to everyone else can create chaos. Unnecessary WAN usage means large monthly long distance charges. A router must let network managers restrict the connectivity to an as needed basis.

For example, network managers may decide to exclude certain departments from using a particular WAN link, thereby making way for other, more important traffic. Protocol independent routers provide access control down to the individual computer level, which means more control over the internetwork.

Communication Priority. Network managers may want to give certain users priority access to the internetwork. They do this by telling routers the addresses of the computer or computers that should get priority. With protocol dependent routers this must be done by providing the address in the form

Router Checklist

Flexible LAN Support. Your router should support all the network types you have and may install, including Token Ring (4- and 16Mbps), Ethernet, and StarLAN. It should also support each cable type, including coaxial, twisted pair, and fiber optic.

Flexible WAN Support. Your router should support all wide-area networks you want to use, including 56/64kbps lines, T-1, Fractional T-1, and X.25.

Multiple Connectivity Support. Your router should connect more than two networks (LANs and/or WANs) at a time. This saves money, isolates traffic and errors, and improves performance.

Protocol Independence. Your router should route every protocol on your network, including those from IBM. Moreover, it should do so in native mode, not through encapsulation or by simply bridging those protocols it does not handle, as many protocol dependent routers do.

Source Routing Transparent Support. Your router should support the source routing transparent bridging standard. This means support for IBM protocols as well as other protocols that do not support source routing.

Mesh Network Support. Your router should enable the creation of mesh networks. These have multiple pathways between any two points, providing significant performance and reliability advantages. Alternate path selection and load balancing support are required to make mesh networks successful.

Comprehensive Network Management. Your router should allow you to gather network statistics and set parameters and reconfigure devices. This includes the ability to control access, isolate stations, give priority to certain users, and limit broadcast messages. And it should allow you to do so from one station for an entire corporate network.

Comprehensive Diagnostics. Your router should let you diagnose enterprise network problems quickly. It should feature segment-by-segment connectivity testing for the entire network, session capture of problem communication session, alarms, and other tools that provide on-line detection and isolation of problem areas down to a network or LAN device level.

IBM Management Support. Your router should work with IBM's NetView umbrella network management scheme. This means supporting LAN Network Manager (LNM) and emulating the LNM Agent software. NetView should see your router as it does all other IBM LAN devices.

Out-of-Band Management. Your router should allow you to get information from it even when the network is down. This can be done through a serial connection or a built-in dial-up modem. This feature makes network troubleshooting far easier.

SDLC Pass Through Support. Your router should support Synchronous Data Link Control, a method of terminal-mainframe communication used in IBM's SNA networks. This eliminates duplicate wide-area networks, one for SNA and one for LANs.

NetBIOS Broadcast Resolution. Your routers should distinguish those NetBIOS broadcast packets meant for other networks and those meant for local LAN devices. By isolating NetBIOS broadcast packets to their appropriate LANs, your router will reduce traffic and increase network performance. This is especially useful when using NetBIOS over WAN links.

that each protocol understands. On a multiprotocol internetwork this can be frustrating since it must be done for each protocol and each protocol has different rules.

A protocol independent router, on the other hand, need know only the physical address of the device to be given priority, no matter what protocol that device is using.

Furthermore, for nonroutable protocols, prioritization is impossible with protocol dependent routers. Only protocol independent routers can give priority to devices using nonroutable protocols, such as those from IBM.

Broadcast Control. A broadcast message is one sent to all computers on a network. Some broadcast messages are meant only for all those on one LAN, others are for all those on several LANs, and a few are for those on an entire corporate network.

Routers can distinguish between these different types of broadcast messages and transmit them when and where needed. This is crucial in large corporate networks that use low speed WAN links between LANs. By keeping unnecessary traffic off the WAN link, routers save money and increase performance.

As with communication priority, protocol dependent routers cannot perform broadcast control on packets sent using IBM protocols since these packets do not contain routing information. Protocol independent routers must be used.

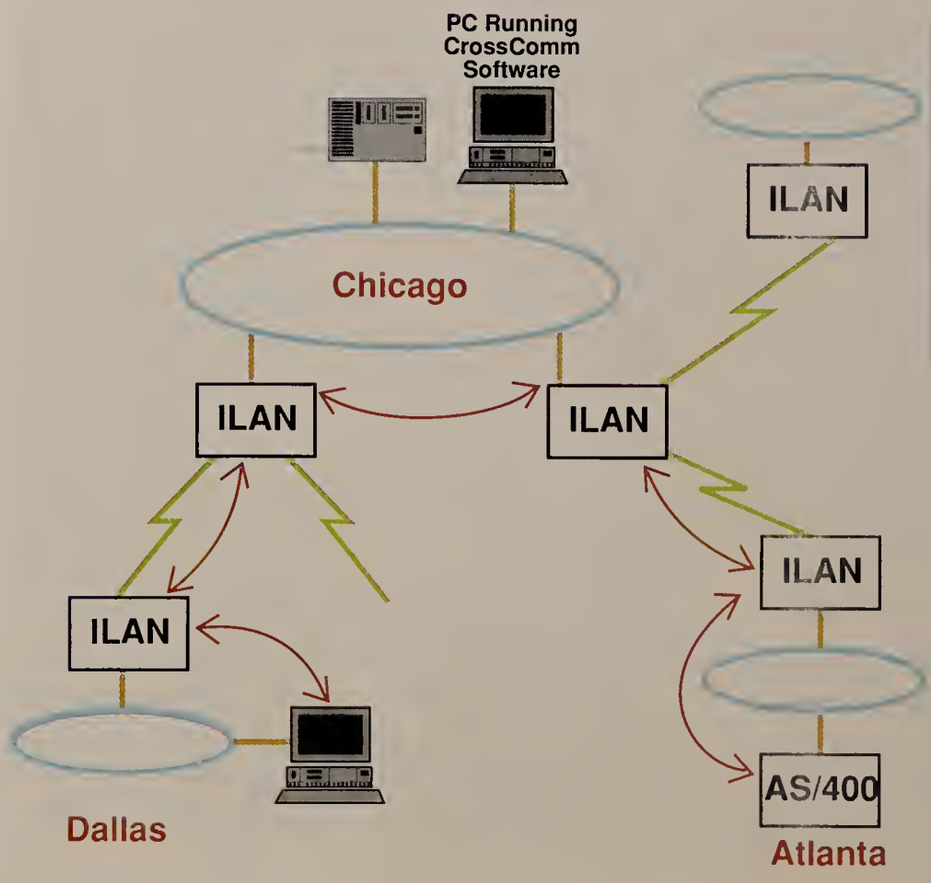
Network Diagnostics. No corporate network is foolproof. When an enterprise network breaks, network managers need all the help they can get to identify trouble. Routers help isolate troubled networks and perform a limited set of diagnostics. Protocol independent routers will actually test connectivity on a device-by-device basis without regard to protocol. This means the network manager need not understand each protocol in detail to perform tests. Again, protocol dependent routers cannot perform these diagnostics for devices running IBM protocols. In fact, most perform this test for the TCP/IP protocol only, giving you no tools to test devices running such other popular protocols as NetWare, IBM LAN Server, or SNA.

SNA Support. Protocol independent routers can combine LAN and remote SNA traffic (to and from remote IBM 3274/3174 type controllers) so that the two types of traffic can be routed over a common enterprise network.

Protocol dependent routers must encapsulate SNA in TCP/IP or some other protocol they understand. This added complexity and overhead slow the network down and make it more difficult to troubleshoot.

Protocol independent routers treat SNA like any other protocol. They route it as it should be routed, reducing overhead and improving overall performance.

APPLICATION HIGHLIGHT: EXPERTTEST FROM CROSSCOMM

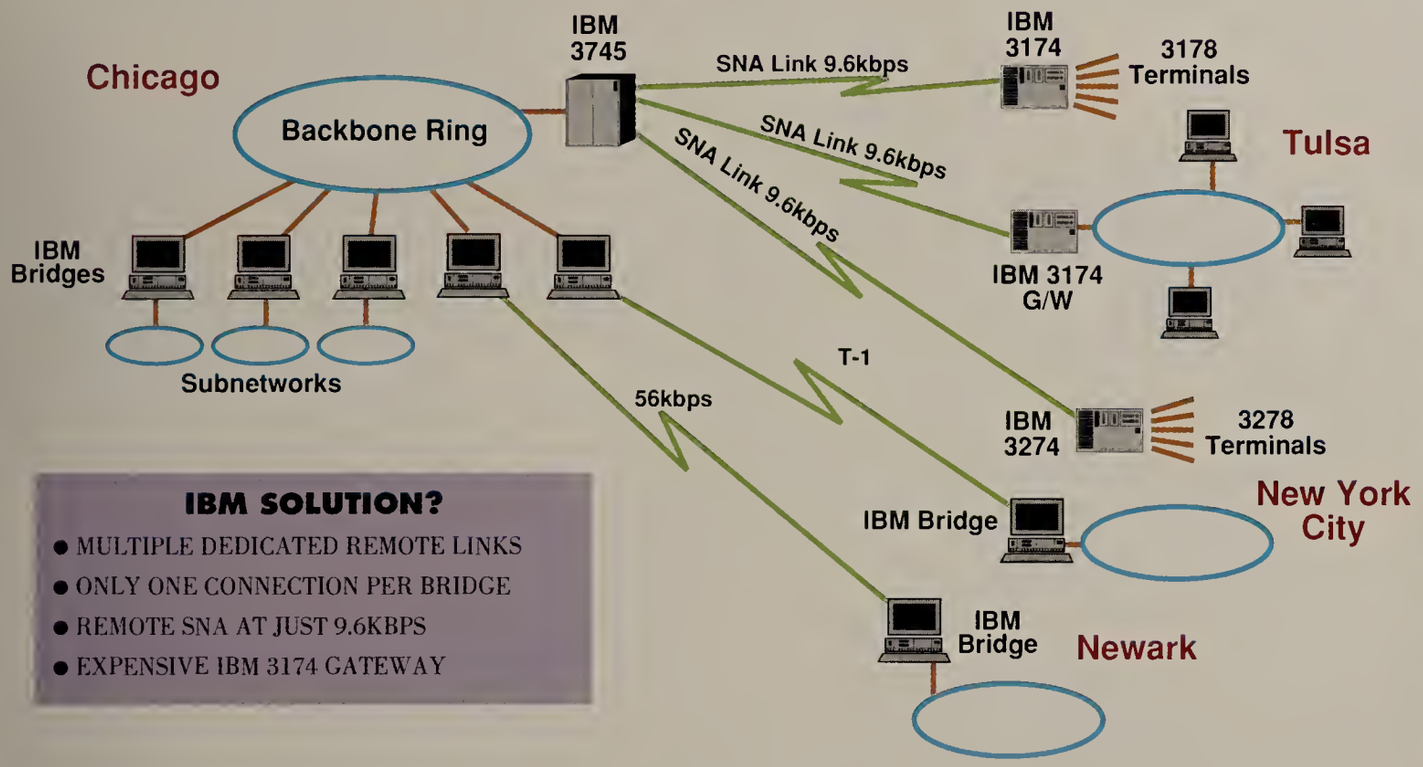


ENTERPRISE NETWORK MANAGEMENT

- PC-BASED DIAGNOSTICS
- REMOTE TESTING
- SEGMENT-BY-SEGMENT TESTING
- TRAFFIC AND ERROR MONITORING
- EASY TO USE
- FIND FAULTS QUICKLY

EXPERTTEST — ExpertTest is a comprehensive network diagnostics software package from CrossComm Corporation. With ExpertTest, network managers can test any segment of the network without leaving their desks. This means that a network manager in Chicago can figure out why a PC in Dallas is having trouble talking to an AS/400 in Atlanta. This ability reduces network down time and the need for a large support staff.

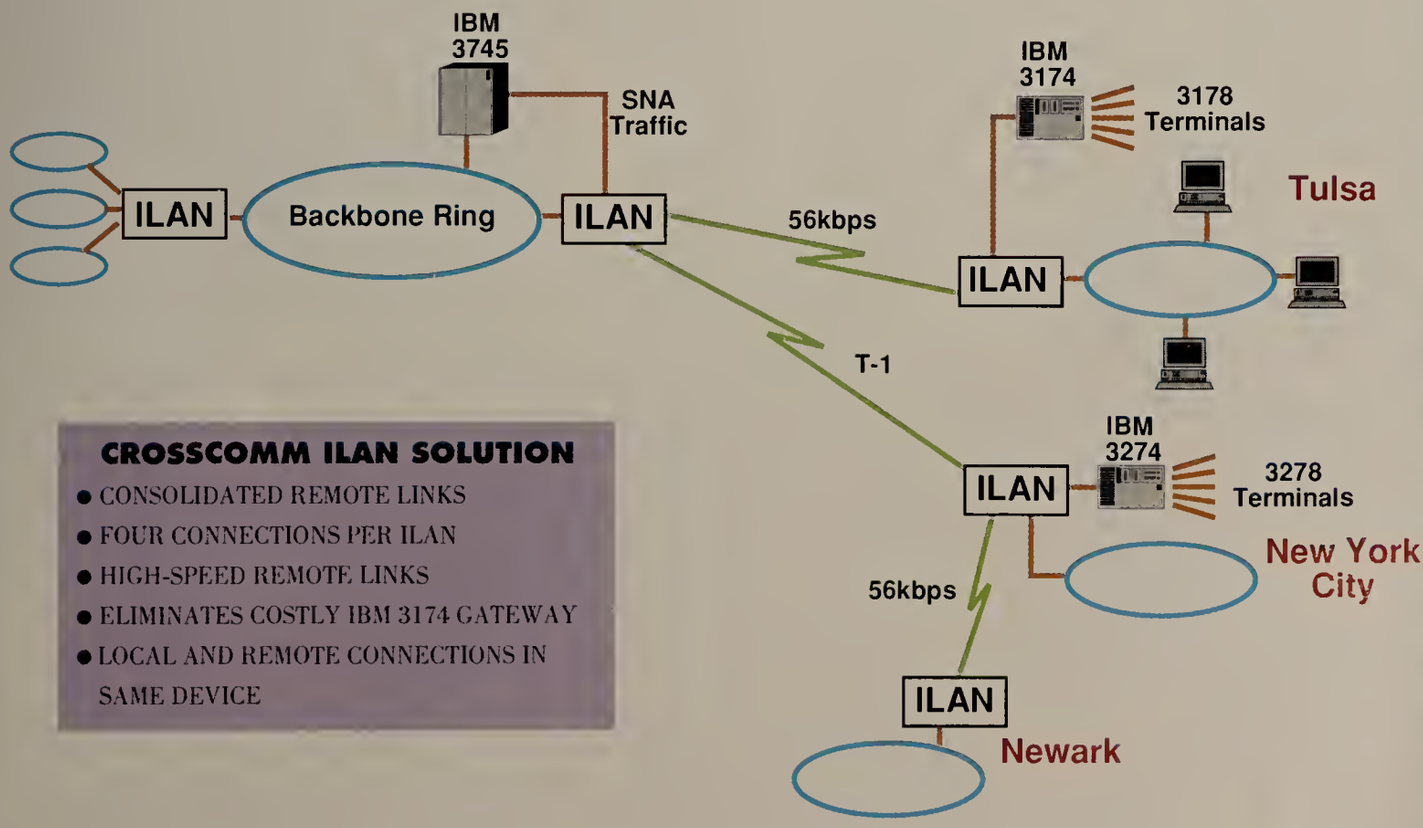
APPLICATION COMPARISON #2: ENTERPRISE NETWORKING



IBM SOLUTION?

- MULTIPLE DEDICATED REMOTE LINKS
- ONLY ONE CONNECTION PER BRIDGE
- REMOTE SNA AT JUST 9.6KBPS
- EXPENSIVE IBM 3174 GATEWAY

CrossComm vs. IBM — *CrossComm's ILAN intelligent routing device simplifies enterprise networking. By handling multiple local and remote links simultaneously, ILAN saves money over the IBM Bridge solution. Only one ILAN does the work of three IBM Bridges. Additionally, ILAN will handle both SNA and LAN traffic over remote and local links. This means users can combine the two types of traffic over the same WAN connections, thereby saving considerable sums on dedicated WAN links. It can also eliminate the need to use an IBM 3174 PC gateway for PC-to-mainframe communications. As a result, the enterprise network built with ILAN is more compact, less costly and higher performing.*

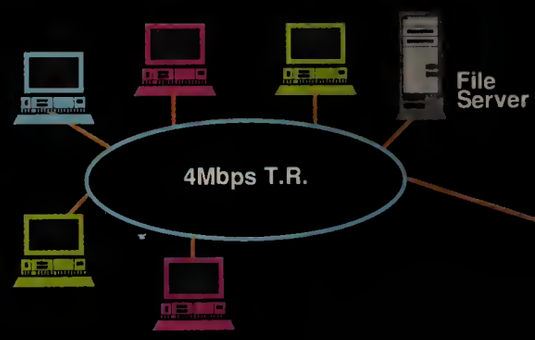


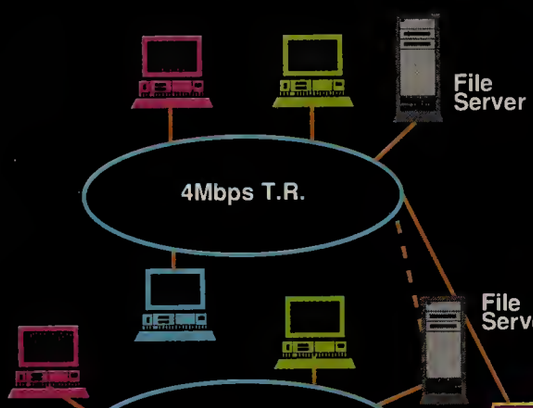
CROSSCOMM ILAN SOLUTION

- CONSOLIDATED REMOTE LINKS
- FOUR CONNECTIONS PER ILAN
- HIGH-SPEED REMOTE LINKS
- ELIMINATES COSTLY IBM 3174 GATEWAY
- LOCAL AND REMOTE CONNECTIONS IN SAME DEVICE

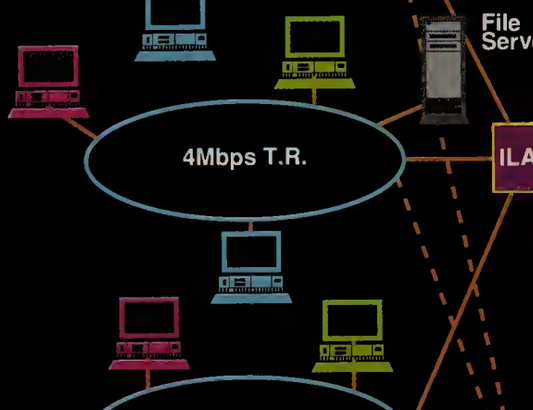
The CrossComm ILAN Solution

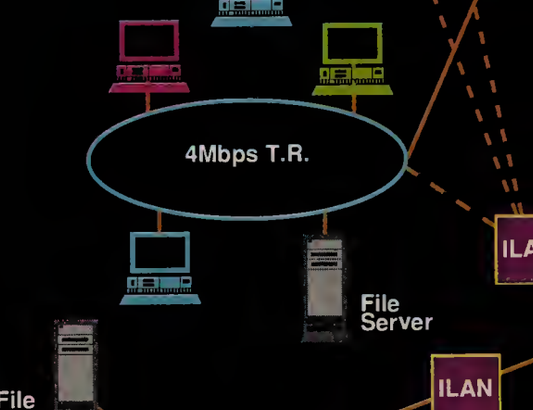
ILAN Protocol Independence: Devices running similar protocols (shown as same color) can communicate regardless of their location or the LAN type they are connected to. Multiple protocols are handled simultaneously and transparently, over local and remote links.

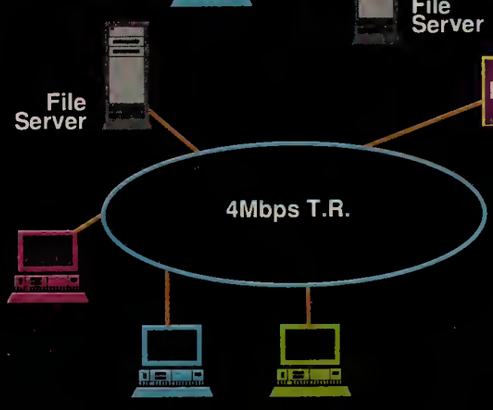


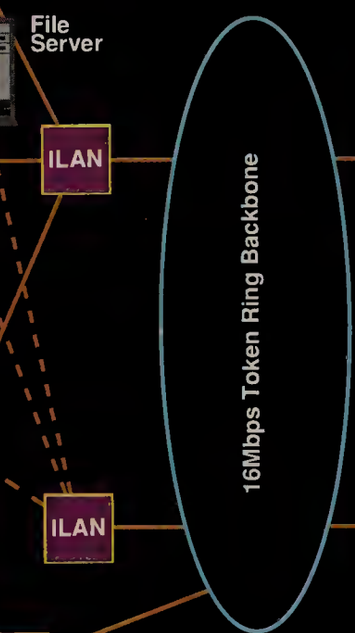


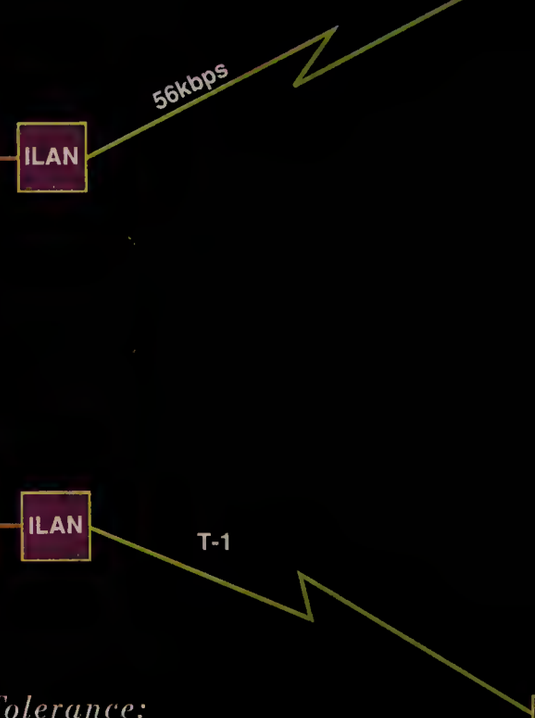
Up to four connections per ILAN saves space, hassle and money.



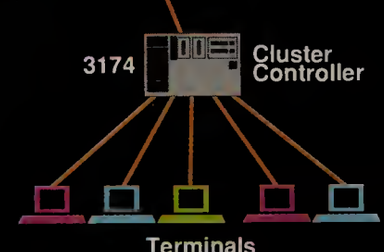






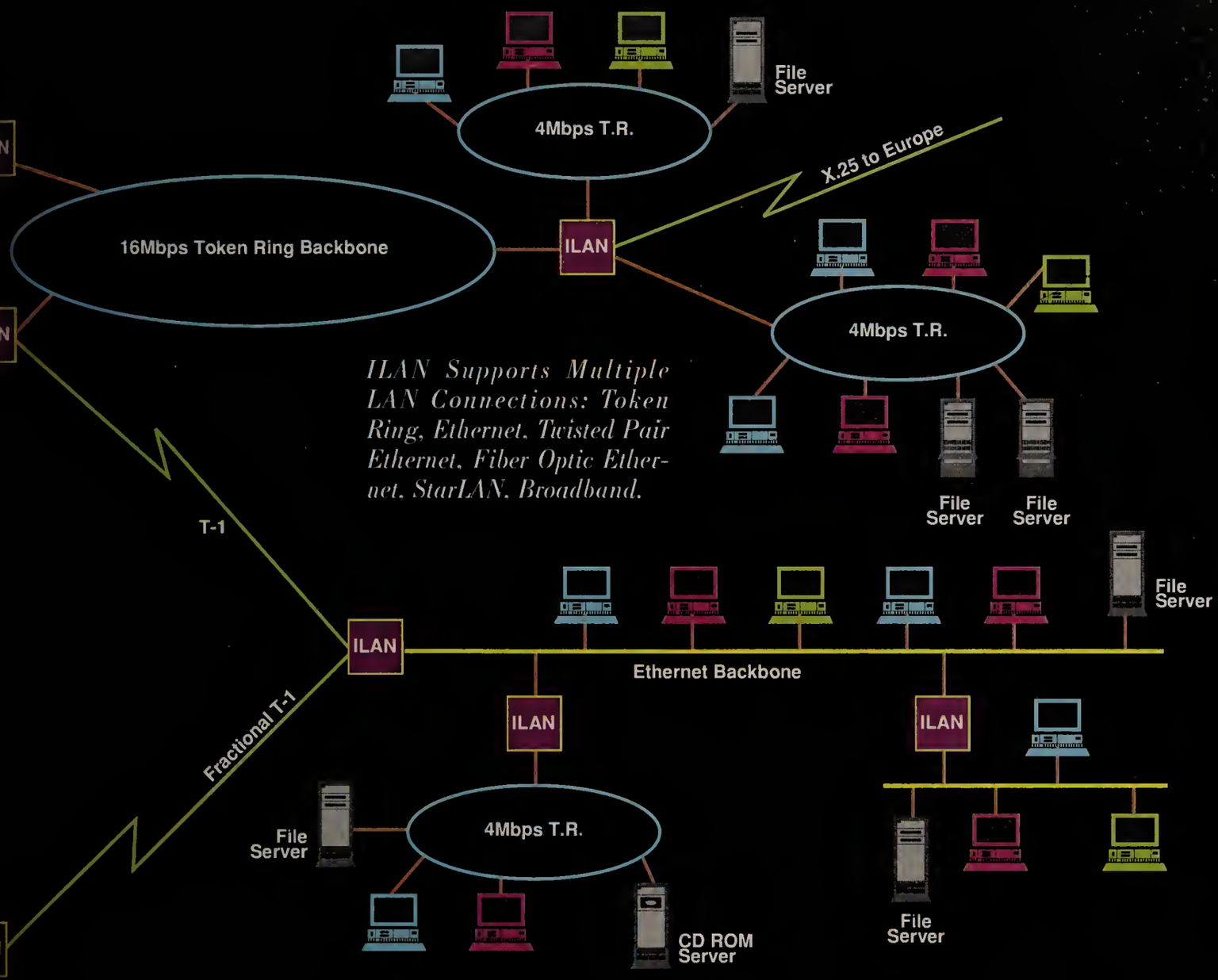


ILAN Fault Tolerance: Connect dual ILANs for greater security. Lose one link and the other takes over, automatically.



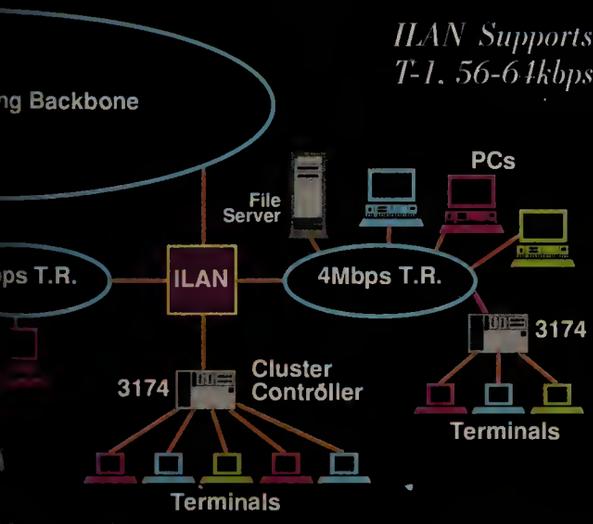
ILAN SDLC Passthrough Support: Put terminals and PCs on the same Token Ring LAN. They can share the same WAN links. ILAN handles SDLC transparently.

ILAN Network Management: ILAN support and LAN Network Manager. Manage the en all communication types — from one station.



ILAN Supports Multiple LAN Connections: Token Ring, Ethernet, Twisted Pair Ethernet, Fiber Optic Ethernet, StarLAN, Broadband.

ILAN Supports Multiple WAN Links: T-1, Fractional T-1, 56-64kbps, V.35/RS422, Frame Relay and X.25.



ILAN Modular Internetworking: ILAN will make up to four network connections. Any combination of supported networks is possible, including LAN and WAN connections in the same unit.

M NetView
network —

INTERNET-WORKING WITH IBM

Big Blue Has Standards But Not Products

Because IBM dominates corporate computing, understanding the pros and cons of its internetworking offerings is essential for building today's corporate networks.

The main internetworking product from IBM is the IBM Bridge. It is a PC-based product that connects two token ring networks. It is assembled by putting together a PS/2 personal computer, inserting two token ring interface cards, and attaching these to two token ring LANs. The last step is to load the IBM Bridge software which performs the forwarding and filtering functions typical of any internetwork bridge.

The IBM Bridge is a source routing bridge. Source routing is a method of data communication developed for token ring networks in which the sending machine provides the routing information necessary to get data from one place to another through an internetwork built with bridges. IBM is the only major vendor to employ source routing, but, given IBM's dominance, most LAN vendors support it.

With source routing, the sending machine places routing instructions into each packet of data it sends onto the token ring. A specific field in each token ring packet, aptly named the routing information field, is available for just this purpose. As the packet makes its way through the internetwork, IBM Bridges read the instructions in the routing information field and decide to forward or filter the packet. If they forward the packet it moves to the next LAN in the internetwork. If they filter (discard) the packet it is already on the correct LAN and on its way to the destination computer.

The only question left is how does the sending computer discover where the destination computer is located in the first place. This is done through the discovery process. In this pro-

cess, each device, say computer A attached to a token ring LAN in an internetwork, broadcasts a route discovery packet. Its job is to find the path to a computer, say computer B.

The route discovery packet propagates across the entire corporate network. Every time it crosses a source routing bridge, the bridge forwards it to the next network (LAN or WAN) and in the process marks its own location in the network (say, between ring 6 and ring 7) by inserting the appropriate information in the route information field of the discovery packet.

By the time the route discovery packet gets to computer B, it will have gathered the location information of all the source routing bridges it has crossed by recording in its Route Information Field the numbers of all rings it travelled on. This is the routing information. Computer B collects this information and responds to device A, sending all the routing information in the response packet. This is how device A "knows" where computer B is located.

If device A wants to communicate with other computers it must engage in the same discovery process for each computer. Also, since the routing information is stored in computer memory (in both device A and computer B), every time one of these computers is powered down it will be lost and the entire discovery process must be repeated.

The major drawback to source routing is that the discovery process causes extra traffic. On local LANs this traffic is incidental, but on wide-area networks it can be costly.

The IBM Bridge is a true bridge, doing its work as a simple packet switch forwarding packets from one LAN to another. It is not a router and therefore does not provide any of a router's features. Also, any computers using a LAN protocol that does not understand the IBM source routing protocol will not be able to communicate across an IBM bridge.

The IBM Bridge also will act as a remote bridge. It can accommodate one serial connection to a 56kbps or T-1 (1.544Mbps) wide-area link. In remote mode, the Bridge works in precisely the same fashion as in local mode, using source routing.

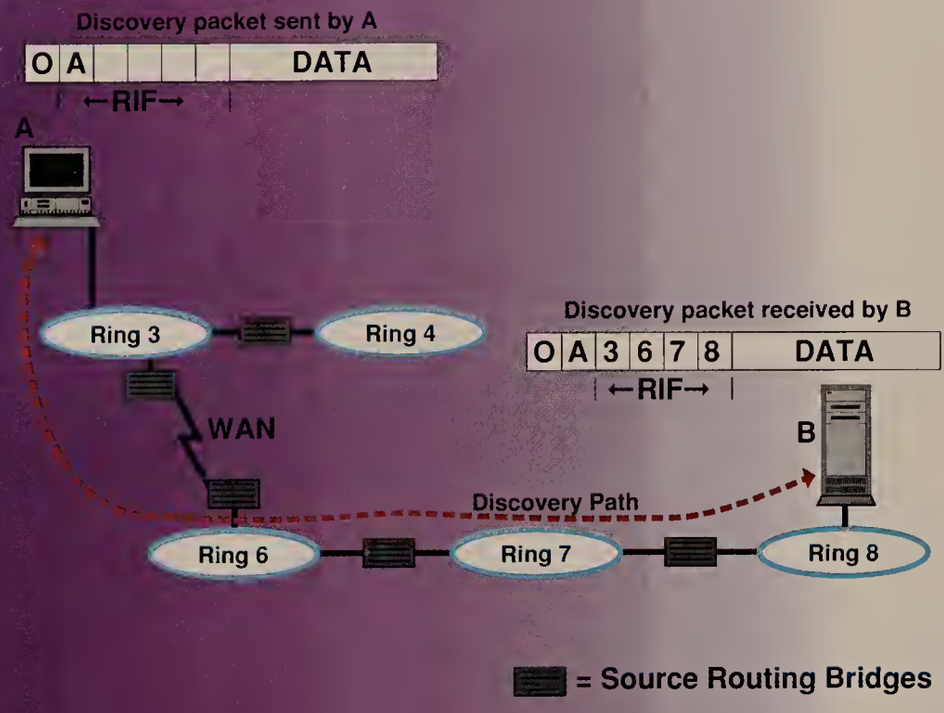
Solution or Problem?

The IBM Bridge is ideal for connecting two Token Ring networks together, especially if they are running only IBM protocols. However, in large corporate internetworks the IBM Bridge has several drawbacks.

As mentioned, the IBM Bridge is customer-assembled using a PS/2. This means it has a floppy disk, possibly a hard disk, keyboard and screen. These all represent possible points of failure and unauthorized internetwork entry. The more IBM Bridges attached to the internetwork, the greater the risk. This is particularly important as more and more corporations run their mission critical applications on their enterprise networks. Think of banking and finance, or insurance, where security is paramount.

IBM does have a dedicated bridge without a disk, keyboard and screen — the 8209. But it is for connecting Token Ring to Ethernet. Additionally, it has no wide-area network support. It is rumored that the 8209 will soon support Token Ring to Token Ring and Token Ring to WAN bridging, but it will still be just a source routing bridge.

Source Routing Explained



How Source Routing Works — *With source routing, the sending computer must know the route its packets will take to their destination. To discover this route, the sending computer sends out a route discovery packet. This is a broadcast packet that propagates throughout the entire network. While this means every network device "hears" the route discovery packet, only the destination computer responds. By the time it reaches the destination computer, the route discovery packet has recorded the path it has taken through the network. As the packet crosses each source routing bridge, the bridge places its network number in the packet's route information field. This collection of network numbers is the route information between the source and destination computers. The destination computer then responds by sending back the route information it received from the route discovery packet. Each time a computer joins the network it must go through this process for every device on the network. This can cause excess traffic and degrade performance, especially when route discovery packets are broadcast across wide-area network links.*

Having only two LAN connections is another drawback of the IBM Bridge. Imagine a building with 20 LANs, each connected to a backbone ring. Such a network would require 20 IBM Bridges. However, several products available from other vendors will connect up to three LANs to the backbone, reducing to seven the number required. This means lower cost, less installation work, greater space savings, fewer maintenance requirements, and, most importantly, better performance.

Why better performance? Because an internetwork device that connects three LANs to a backbone will keep their internal traffic off the backbone, thereby improving performance for everyone.

The final drawback of the IBM Bridge is that it supports only source routing protocols. While it is logical for IBM to give preference to its own products, in today's

Novell's Internetwork Solution

The dominant vendor of PC LAN operating systems is Novell (Orem, UT) and its product is NetWare. Like IBM, Novell has built a product, NetWare Bridge, that is adequate for small local LAN-to-LAN connectivity, but fundamentally flawed in the large, multiprotocol environments of today's enterprise internetworks.

The NetWare LAN operating system has its own proprietary protocol, called IPX. In addition to other things, this protocol specifies how packets are to be sent on an internetwork. NetWare Bridge, Novell's PC-based internetworking device, understands and uses IPX to make its forwarding decisions. Given this reliance on IPX, NetWare Bridge is really an IPX router. Bridges are protocol independent and an IPX router is not. It depends on the IPX protocol.

In addition to being misnamed, NetWare Bridge has all the significant drawbacks of the IBM Bridge. It is PC-based, making it a security risk. It makes only one interconnection, making it more expensive and less efficient. And most seriously, it supports only one proprietary protocol, IPX.

Thus, like IBM, Novell is not prepared to build the large multiprotocol enterprise internetworks that are needed to run today's mission critical applications.

corporate environment no vendor can claim exclusivity. In fact, IBM has recognized the importance of supporting more than source routing. It has been instrumental in establishing the Source Routing Transparent (SRT) bridging standard. This is an industry standard that allows a bridge to be both a source routing and a transparent bridge.

Transparent is the name given to those bridges that follow the spanning tree routing protocol standard (802.1D) established by the IEEE.

With an SRT bridge, corporate internetworks can run many different types of protocols simultaneously, including those from IBM.

How do SRT bridges work? They examine all packets that come their way. Those that are using source routing are source routed. The process is identical to that which takes place in the IBM Bridge. Those packets that are not using source routing are bridged transparently.

Significantly, IBM does not have a source routing transparent product on the market. This is despite the fact that the company was the prime mover behind the SRT standard. As a result, IBM does not have the hardware to build the large, multiprotocol corporate internetworks that are required today.

Network Management

In the realm of network management, however, IBM has created a set of standards upon which most large corporate networks can rely, especially those using Token Ring. The IBM scheme exploits the inherent network management capabilities of the Token Ring standard. These allow for the management of every Token Ring connection on the network. Managers can gather traffic statistics, configure priorities, monitor for errors, and isolate faulty connections.

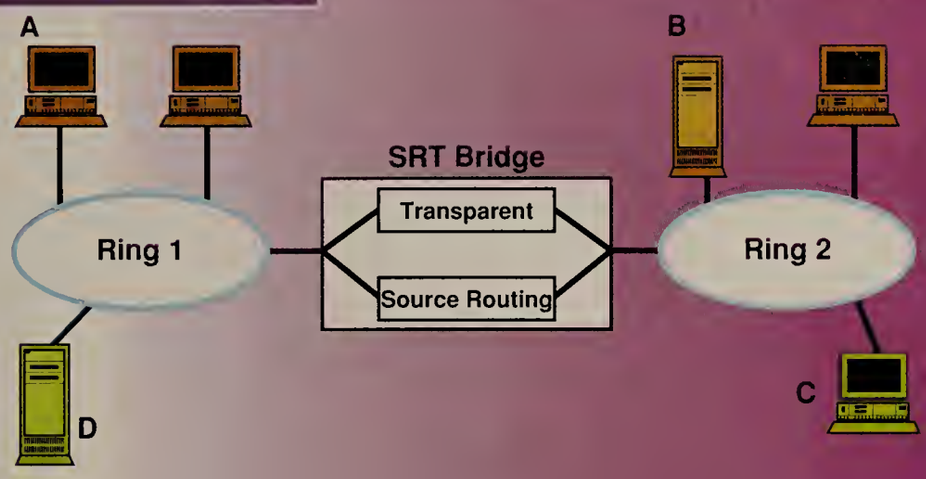
The centerpiece of the IBM network management scheme is LAN Network Manager (LNM). It is a software program that runs in a PS/2 on the network. It gathers information from all the Token Ring connectors (adapters) on the network and issues the network manager's configuration commands. The diagnostic information picked up by the LAN Network Manager is inherent on all Token Ring networks. The messages sent are defined in the IEEE 802.5 Token Ring standard, which virtually every Token Ring vendor follows. Every Token Ring adapter periodically transmits information about its activity. If there is no LAN Network Manager or equivalent program from another vendor available to interpret this information, it is simply ignored. With the LAN Network Manager, it is exploited for the purpose of network management and configuration.

There is one complication, however. Information sent by Token Ring adapters may not leave the ring in which it originated. This is simply a rule of the IEEE 802.5 standard. As a result, some mechanism is needed to pass this information between LANs. Without such a mechanism, each ring would have to be managed separately, an impossibility on any corporate internetwork.

In the IBM scheme, Token Ring diagnostic information is moved from LAN to LAN, by the LAN Network Manager Agent, a piece of software running in IBM's internetworking devices — the IBM Bridge. It moves the information from one LAN to the next, allowing one LAN Network Manager station to monitor and configure an entire internetwork.

As described above, the IBM Bridge has some serious flaws. Fortunately, several vendors have adopted the IBM network man-

Understanding SRT



Source Routing Transparent -- *A source routing transparent bridge combines two types of bridging -- source routing and transparent -- and it does so simultaneously. Computers A and B are running LAN software that supports source routing (e.g. IBM software). The SRT bridge will use the source routing method to forward packets between them. Computers C and D are running non-source routing software (e.g. Novell NetWare). The SRT bridge will use the transparent mode when handling their traffic. It distinguishes between the two types of traffic automatically and forwards LAN packets accordingly. The SRT bridge is a universal device that bridges any protocol that may run on a Token Ring LAN.*

SNMP AND TOKEN RING

One of the emerging network management standards is Simple Network Management Protocol. It has several advantages. First, it is an open protocol, available to everyone. Second, many vendors are implementing the standard, making it possible to use it in heterogeneous environments. And third, it has been around for some time, so there are people who understand it and products that have been improved with it.

However, there are several disadvantages to SNMP. First, as it has been developed, SNMP only defines methods for gathering limited statistics and setting limited parameters. Some network management vendors have defined their own extensions to the SNMP standard in order to accomplish these tasks, but by doing so they have created proprietary products that other vendors do not support.

Third, SNMP is not designed to manage all the way down to the adapter level the way IBM's LAN Network Manager (LNM) is. That is, SNMP does not include the ability to change the way particular network devices operate. Each device must be reconfigured individually. IBM's LNM does provide parameter setting and device reconfiguration for Token Ring networks. Of course, LNM is a proprietary product, but the ubiquity of Token Ring and IBM makes it a *de facto* standard.

Finally, SNMP was developed in the TCP/IP world. Its advantages are in that world, not in the large IBM Token Ring environment.

agement scheme and equipped their internetworking devices with software that emulates the LAN Network Manager Agent. This means that the IBM LAN Network Manager can be used to monitor and configure these devices and to manage all the Token Ring LANs in the enterprise network. Two vendors of LNM-compliant internetworking devices are CrossComm Corporation (a router vendor located in Marlboro, MA) and Andrew Corporation (a bridge vendor located in Torrance, CA).

The importance of compliance with LAN Network Manager cannot be underestimated. LAN Network Manager works as one piece of IBM's overall network management product: NetView. NetView integrates the management of every type of IBM network, from its PC LANs, through its minicomputer networks, all the way to its mainframe networks. It is an essential tool for managing the diverse resources on the IBM SNA internetworks that dominate in today's largest corporations.

Internetworking devices that do not support LNM cannot be integrated into the NetView scheme, meaning they must be managed separately. This increases cost and hassle. Also, these devices do not allow managing of remote Token Ring LANs using the IBM LAN Network Manager at a single location. Internetworking devices that do not support LNM are invisible to NetView, thus making it impossible for NetView to get information about such possible problems as faulty multi-access units, cables, Token Ring adapters, bridges or routers.

IBM Strategy Summary

IBM has built large mainframe-based networks for the world's largest corporations. In developing a Token Ring internetworking strategy, the company has focused on the protocols for those environments. That is why its IBM Bridge handles only IBM's source routed protocols. Unfortunately, while this strategy works in the few corporations that use only IBM protocols, it fails in the majority of corporations that have multiprotocol networks.

What IBM has failed to realize is that virtually any LAN-based computing strategy is necessarily heterogeneous. No company, not even IBM, can deliver the solutions for every computing platform. That is why companies like Novell, Sun, Hewlett-Packard, DEC, and many others are still in business.

As a result, when building an internetwork to share all of its computing resources, every large corporation must work with multiple protocols. It is a fact of life in enterprise networking.

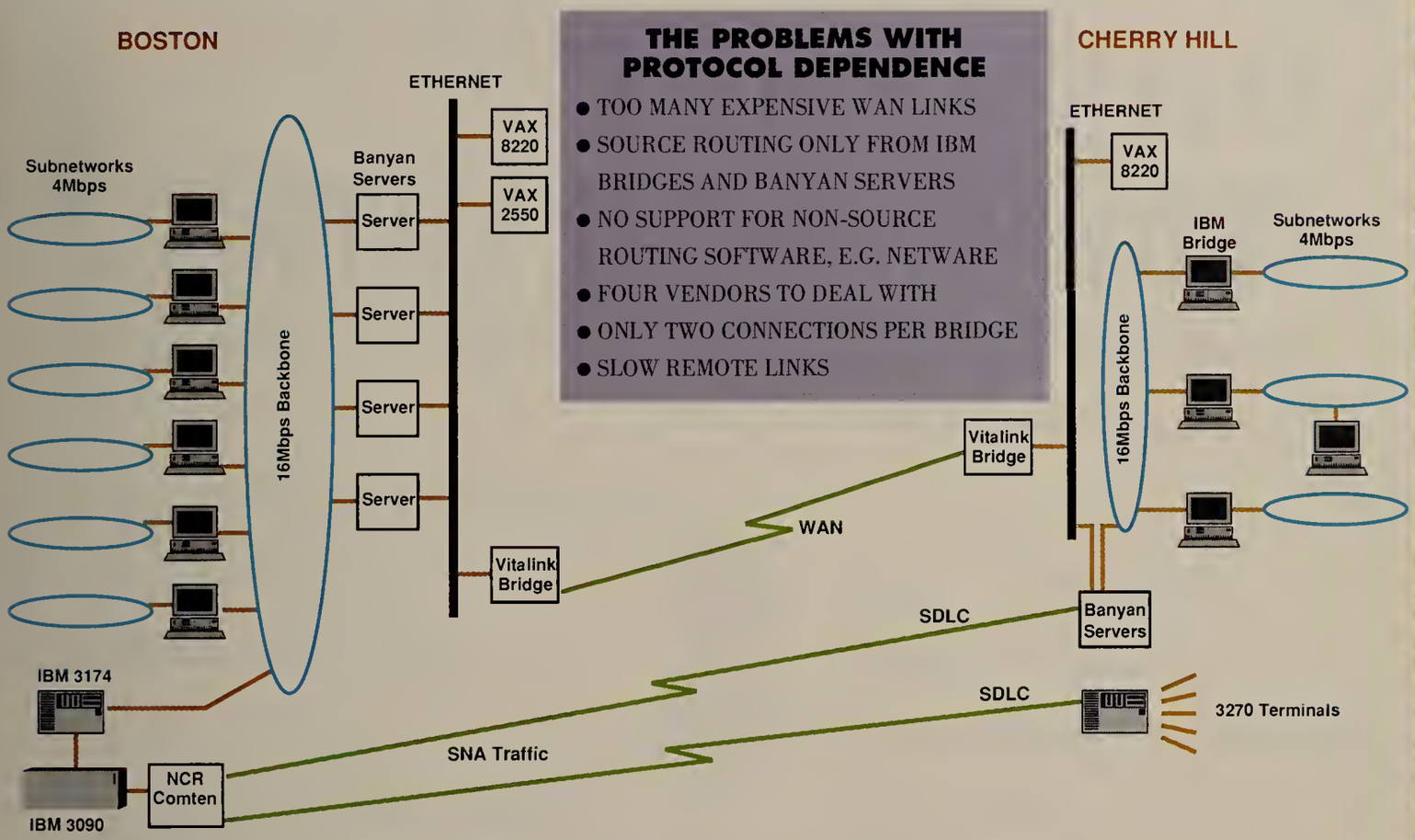
Interestingly, IBM has recognized the importance of multiprotocol support, as evidenced by its support for the source routing transparent bridging standard. Curiously, it has not shipped a product.

Fortunately, other internetworking vendors have recognized the importance of supporting the plethora of protocols that exist in most large companies. And they have shipped products that do so.

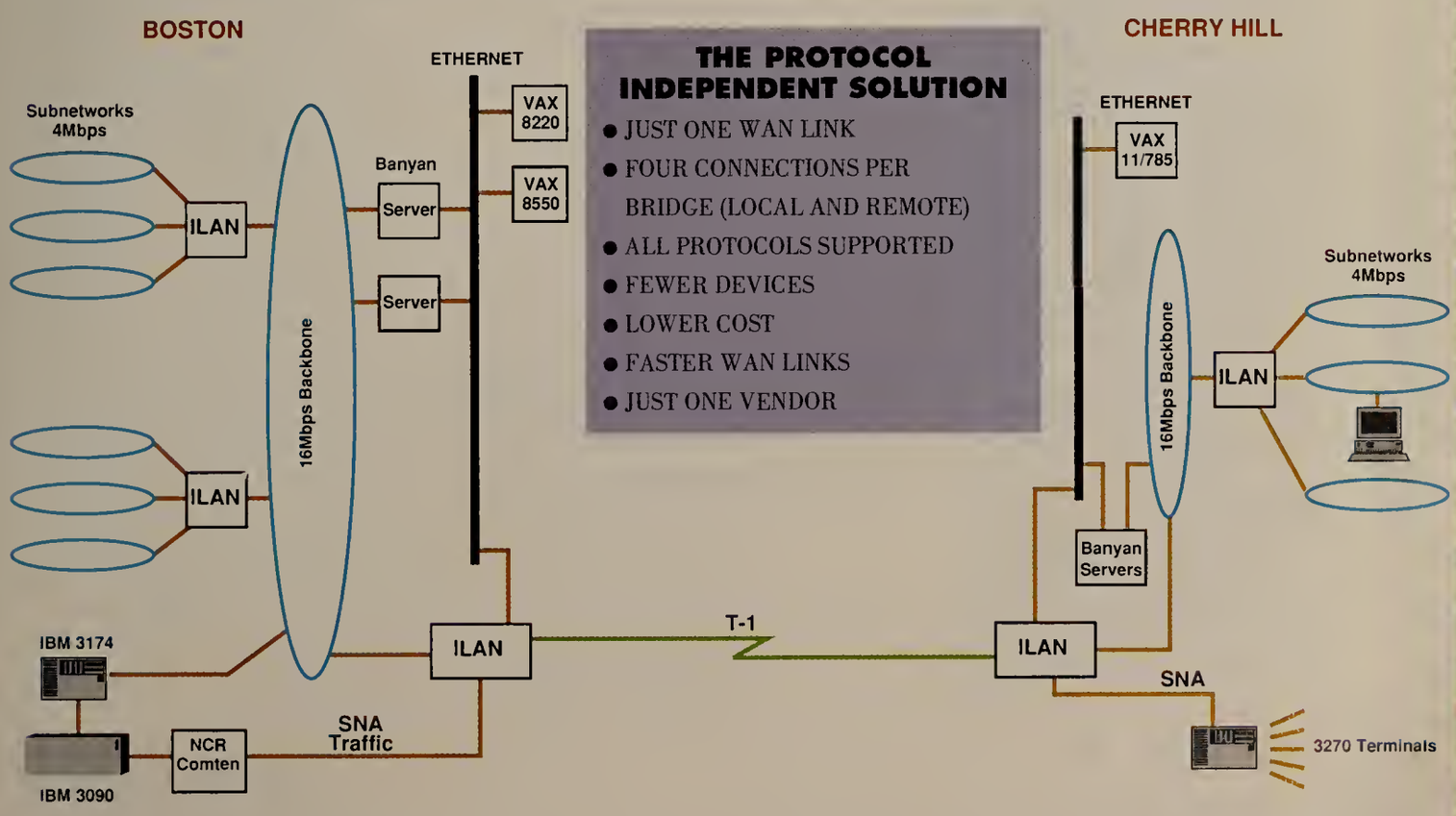
Even more fortunately, a couple of these vendors have introduced products that work with IBM's NetView comprehensive network management scheme.

Thus, it is possible to have the best of both worlds. Large corporations can internetwork both IBM and non-IBM protocols, and still manage their internetwork with a powerful, and familiar, network management tool: IBM's NetView.

APPLICATION COMPARISON #3: PROTOCOL INDEPENDENCE



Protocol Independent Networking — *A protocol independent routing device solves many network problems at once. Above, four vendors are needed to make the internetwork connections — IBM, DEC, Banyan and Vitalink. Below, only one vendor, CrossComm Corporation, is used. CrossComm's ILAN routing device handles every protocol used, including Ethernet, Token Ring, SNA, VINES, DECnet, and any others the company should wish to add. ILAN eliminates the need for multiple WAN connections between the two cities and reduces the number of bridges between subnetworks and backbones. ILAN also improves performance by using T-1 speeds instead of 9.6kbps lines for SNA traffic. The result is fewer maintenance difficulties, higher performance and lower costs.*



INTERNETWORK PROVIDES ROYAL SAVINGS

Royal Bank of Canada's LAN-based Strategy Pays Off

In the 1980s, Royal Bank of Canada discovered the benefits of local area networks. Now, in the 1990s, it is realizing the savings from internetworking those LANs.

★

Royal Bank of Canada (RBC), headquartered in Montreal, is the perfect candidate for internetworking. It is the largest bank in Canada and the third largest bank in North America by asset. It has $110 billion in assets, 55,000 employees, and 7 million retail clients. And it relies on its computer systems for virtually every aspect of its operations.

Like many other corporations, RBC was changed by the introduction of the personal computer and the subsequent development of local area networks. These two technologies presented every office with a platform of such great productivity they could not be ignored.

But the applications provided by PCs and LANs are different than those that run on mainframe computers. While spreadsheet, database, and word processing applications all work on a mainframe, in many cases they make far more sense on a PC. And while transaction processing and other bank applications may be done on a PC, they are more sensibly run on a mainframe. The trouble is, the same people often need access to both types of applications.

RBC recognized that the way to integrate the two platforms was with internetworking. By switching mainframe terminal users to LAN-attached PCs, and by interconnecting LANs and mainframes, RBC can give employees simultaneous access to PC, LAN, and mainframe applications and data. This access, soon to be available from every part of the bank, will improve the service RBC offers its customers, from the processing centers to back office operations to the hundreds of local branches.

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. . . *from CrossComm Corporation*

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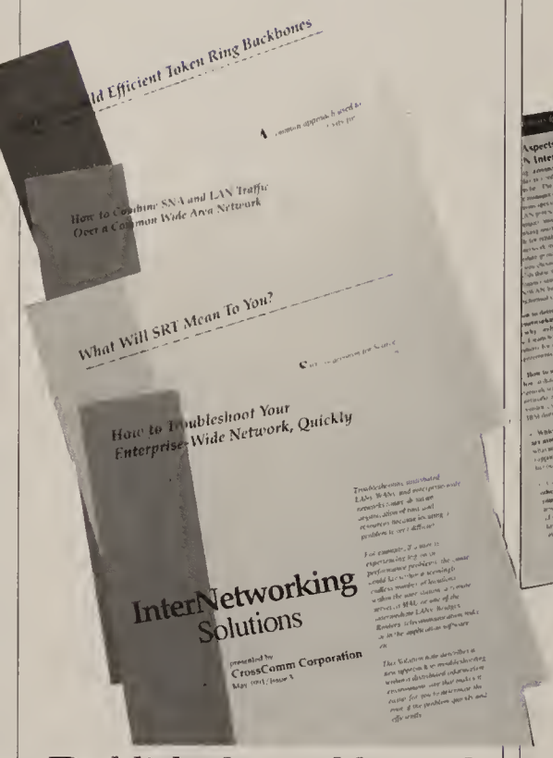

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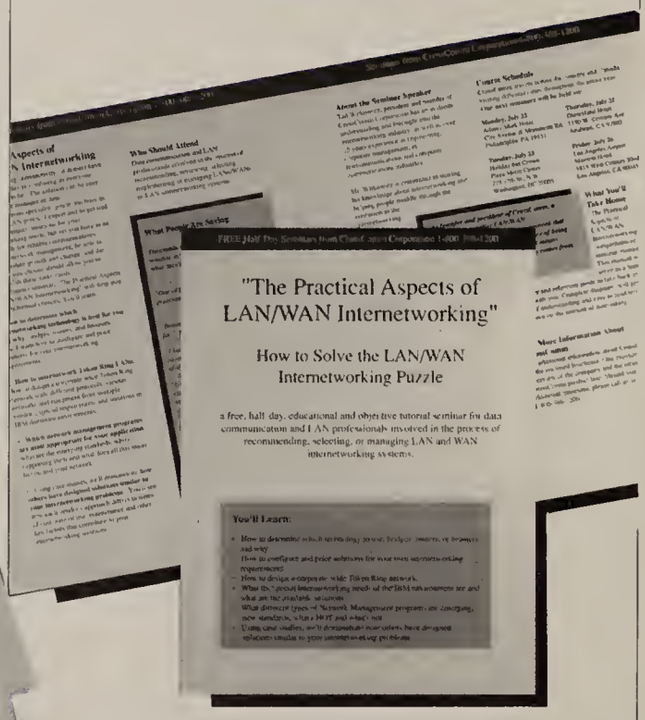

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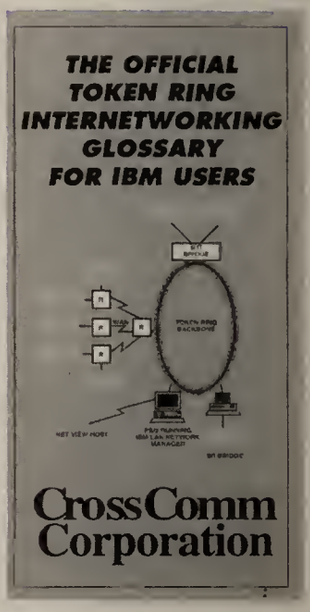

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Although the bank has deployed LANs in its headquarters location for several years, the planning to migrate the 1600-branch network from branch controllers started in 1988. In the beginning of 1990, the bank began to implement a strategy for internetworking all its 1600 branches with LANs. Given the bank's size and the complexity of its systems, building the internetwork will be done in phases and will take several years.

Nonetheless, it is already paying off.

Planning

Before beginning research and development for the internetwork, RBC set out some requirements.

First, the internetwork had to support the IBM mainframe traffic of the bank. Second, it had to connect all the LANs in a uniform network that allowed centralized network management through IBM NetView. Third, in addition to the mainframe support, the internetwork had to support the many other operating environments and protocols used by the bank, including Novell NetWare and IBM LAN Server.

Fourth, although the bank is a heavy IBM user and most of its LANs are Token Ring, Ethernet support was required for the interconnection of Tandem hosts. Fifth, the internetwork had to support fiber optics. And finally, the internetwork had to be flexible enough to accommodate new protocols and new transmission standards (especially FDDI, Fiber Distributed Data Interface).

Once the requirements were in place, RBC developed an implementation plan. In addition to a series of phases — certain buildings, certain systems, the branches — RBC decided to create a series of test environments before bringing the production systems on line.

The first guinea pig for the internetwork was the building at 315 Front Street in Toronto, home of the Systems and Technology division, the division responsible for the bank's systems development.

Front Street

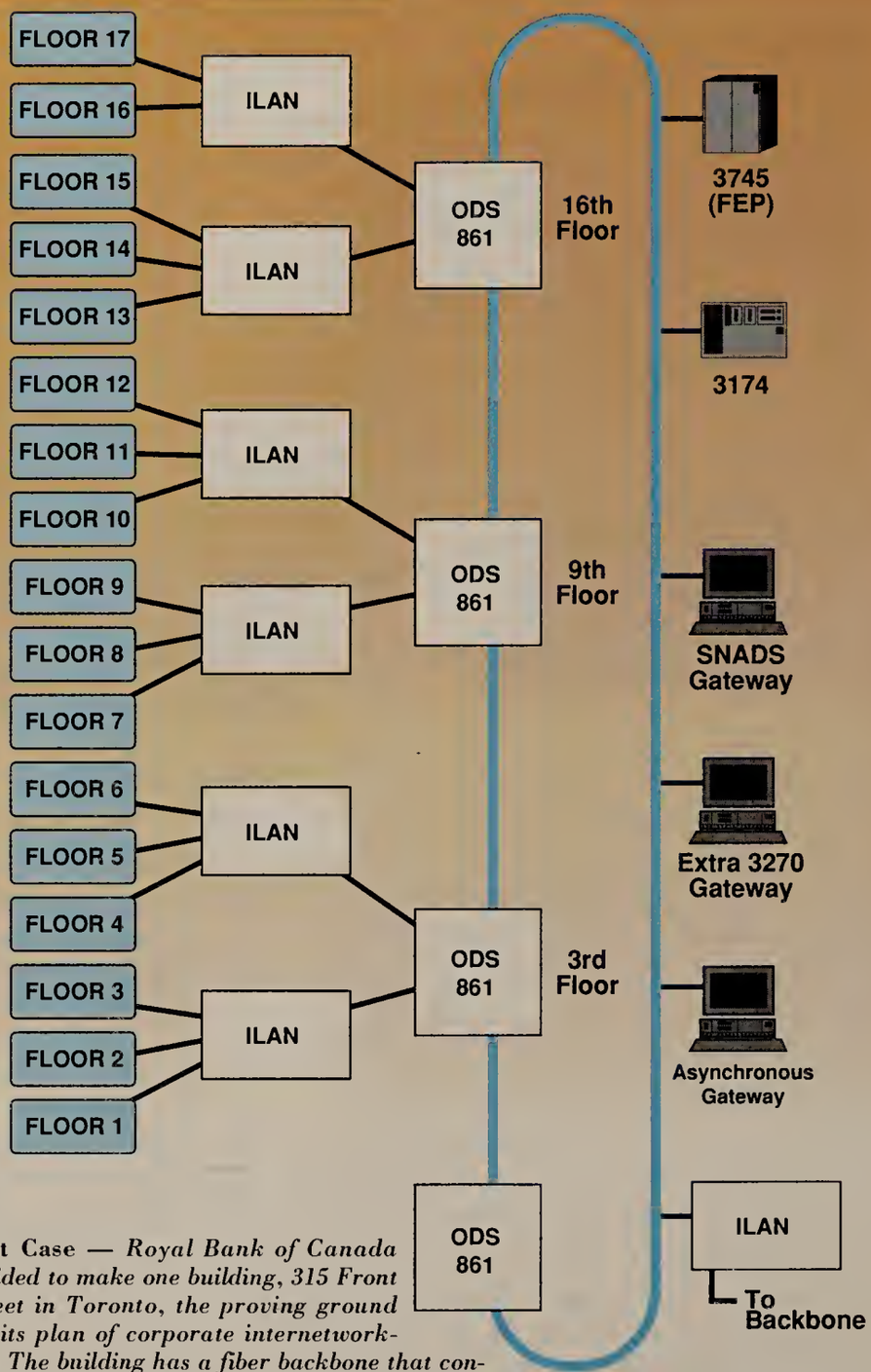
315 Front Street has 17 floors. All have at least one Token Ring LAN running at 4Mbps. These are connected to a fiber optic backbone that runs the height of the building at 16Mbps (see figure).

The fiber optic backbone was created by running multimode fiber optic cable through four wiring closets on three different floors, one on the ninth, one on the 16th, and two on the third.

Following the logic of Token Ring, which uses something called a star-wired ring cable plan, each closet is equipped with an intelligent multistation access unit (MAU) — the ODS 861 from Optical Data Systems. Like all MAUs, the ODS 861 is equipped with a Ring In and Ring Out port. By attaching the Ring In on one MAU to Ring Out on another, the ring is created. Each MAU then connects some number of devices to the ring. The ODS 861 uses fiber between Ring In and Ring Out ports, but its device ports accept either copper or fiber optic cable.

To connect each of the floor LANs to the backbone ring, RBC uses ILAN from CrossComm. This is an intelligent routing device that can concentrate three floor LANs for connection to the backbone. The advantage of this concentration is twofold. First, money is saved since fewer devices are needed. Second, traffic

RBC's Internetwork at 315 Front Street



Test Case — *Royal Bank of Canada decided to make one building, 315 Front Street in Toronto, the proving ground for its plan of corporate internetworking. The building has a fiber backbone that connects all the floor LANs as well as other computer resources, including E-mail gateways (SNADS), 3270 gateways, an asychronous gateway, and mainframe connections through either 3174 cluster controllers or 3745 front end processors. As the testing at 315 Front Street finishes, RBC is replicating the building's scheme in its other buildings in Toronto and throughout Canada. The ODS 861 is a multiaccess unit (MAU) that has both fiber and copper connections. The floor LANs connect to the backbone through CrossComm ILAN devices, one of which is also used to connect the building backbone to RBC's private campus fiber network that links RBC's other buildings in downtown Toronto.*

between the three LANs is not put onto the backbone, thereby reducing backbone traffic and increasing performance. In contrast, IBM's own Token Ring bridging device only supports one connection.

In addition to connecting the floor LANs together, the fiber optic backbone connects several other resources, any of which may be accessed by authorized users throughout the building. These resources include a 3745 front end processors, 3174 cluster controllers, both for connection to mainframes, a SNADS gateway for host electronic mail, a 3270 gateway for Novell NetWare users, and asynchronous servers for dial in and out services.

The users on the floor LANs are running two different LAN operating systems, Novell NetWare and IBM OS/2 LAN Server. Each has access to the same services, though the methods might be different. For example, LAN Server users make host connections through a 3745 front end processor or a 3174 cluster controller, each connected to the backbone ring. NetWare users must use a 3270 Extra! gateway from Attachmate, also attached to the backbone. Despite the different methods of connection, the result is more or less the same.

Both user types have the same access to electronic mail. Microsoft's PC E-Mail is the electronic mail program used. It provides a transparent gateway between mainframe and LAN E-mail. LAN users sending mail to users on the host computers need only choose the name and PC E-Mail takes care of the rest. The same is true in the other direction. The bank has committed to 15,000 licenses of Microsoft PC E-Mail over the next three years.

In the future, the fiber

optic building backbone can be upgraded to use the 100-Mbps Fiber Distributed Data Interface (FDDI) standard without being rewired. All that will be necessary is to modify or replace the closet equipment.

Campus Ring

In addition to the building at 315 Front Street, RBC is networking three other downtown Toronto buildings in similar fashion. To connect the buildings, RBC has laid fiber optic cable. At the moment, this fiber optic cable is the medium for a private T-1 network between the buildings. In the future, it will be a campus 16Mbps Token Ring. This flexibility is made possible by the ILAN device.

Right now, each building backbone has an ILAN device attached. This device contains a Token Ring adapter for connection to the backbone and a T-1 adapter for connection to a T3 multiplexer, which then puts the traffic on the campus fiber optic network.

Once the fiber optic campus ring is complete and tested, the multiplexer will be removed. In place of the T-1 cards, the ILANs will be equipped with 16Mbps Token Ring cards. As a result, RBC communications capacity on the campus ring will grow more than eight times since T-1 only supports speeds up to 1.544Mbps.

Just as the backbone ring at 315 Front Street provides access to mainframe and other resources, the campus backbone will do the same. In addition, it will provide connections to the bank's Toronto processing centers, called OPC (Ontario Processing Center).

Since LAN connections run both ways, OPC will be the center of internetwork management. At OPC, the bank will build a network management ring with connections to the rest of the internetwork through the campus ring. The network management ring will have all the diagnostic equipment for the entire internetwork, including the IBM LAN Manager (LM) station.

The LM station monitors the network for diagnostic information from all Token Ring devices. To move this information through the network, the ILAN devices play a crucial role. When individual Token Ring devices send out their diagnostic information, this information must stay on the local ring according to the Token Ring standard. The ILAN device, however, can forward this information from ring to ring. Moreover, it does so by emulating software, called LAN Manager Agent developed by IBM for its IBM Bridge. By doing so, ILAN can be managed along with the rest of the Token Ring equipment through IBM's LAN Manager.

With the combination of the ILAN devices and the LAN Manager station, it is possible for RBC network managers to see every Token Ring device on the internetwork. Any trouble spots, such as a faulty access unit, bad adapter or broken bridge, are immediately isolated. In a network as large as that at RBC, this is crucial for maintaining the network and avoiding expensive down time.

Another function of the campus ring will be to handle traffic between the treasury systems department and the Tandem host. Right now, this traffic moves over a T-1 link. In the future, since the Tandem host and the Treasury systems department are both on Ethernet, the ILAN devices will be equipped with Ethernet as well as Token Ring adapters. They will convert from Ethernet to Token Ring and then back to Ethernet, allowing the campus ring to handle this traffic as well.

As with the building rings, the campus ring can be upgraded to FDDI with minimal hassle.

Savings

RBC's internetwork will save a tremendous amount of money by eliminating expensive communications links. All remote users now attached to mainframes through 4.8kbps lines from the phone company, will be connected through the internetwork. Either they are PC users who get to the mainframe in one of the two ways already described, or they are still terminal users whose cluster controllers communicate with front end processors over the internetwork. In both cases, hundreds of phone lines are eliminated. And the speed of communications is multiplied by a factor of 1000 in some cases. In addition, the bank is deploying an internal Northern Telecom data packet network backbone which will be used to connect remote LANs in geographically dispersed locations.

PC users also eliminate the need for cluster controllers since they are directly attached to the network.

Eliminating phone company links means network management is done in house. The phone company is no longer involved in managing and maintaining any of the internetwork's links. Network managers have complete control.

The Internetwork's Impact

In moving the company from terminal-host computing to PC network computing, RBC's Systems and Technology division has provided bank employees with a slew of new productivity-enhancing applications, while leaving them access to their old ones. At the same time, it has saved the company significant amounts of money while enhancing the ability to manage its vast computing resources.

DISASTER RECOVERY EXPERTS RELY ON NATIONWIDE TOKEN RING INTERNETWORK

CDRS Links Eleven Offices Across the Continent

Comdisco Disaster Recovery Services (CDRS) in Rosemont, IL, is one of the leading computer disaster recovery companies in North America. It has eleven offices in the United States and Canada. Each one of these sites houses the latest and greatest mainframe and minicomputer equipment, all at the beck and call of customers who have contracted for CDRS' disaster recovery services.

When customers' computers go down they bring their backup tapes to CDRS. The tapes are restored and run on CDRS computers, while the customer's telecommunication links are rerouted to the CDRS facility. Thus, users have the same access to their applications without leaving their office, even while their own computer equipment is inoperable. Using this method, CDRS has returned computer service to customers suffering such disasters as floods and power outages in a matter of hours.

Though CDRS is on the cutting edge of computer technology, until last year the company had no systematic method for sharing information between its eleven sites. Then it built a nationwide network of Token Ring LANs that gave each site easy access to every other site, and to a new IBM AS/400 at headquarters that runs the company's crucial business applications.

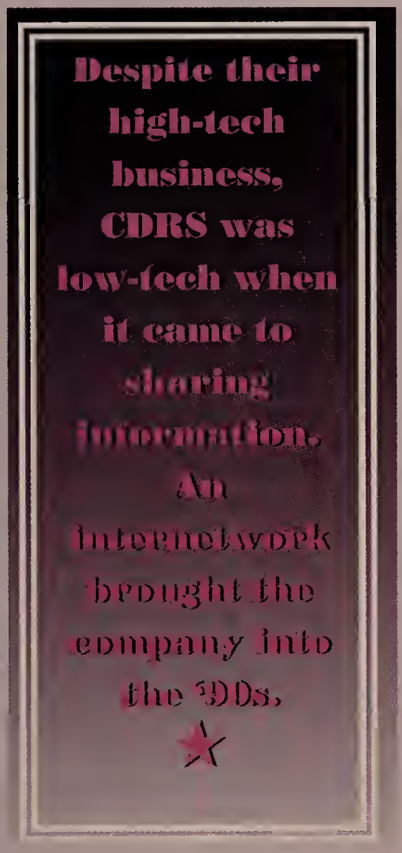
"Prior to the

installation of the internet we had islands of information," says Jim Ziegler, manager information systems at CDRS headquarters in Rosemont. "Each location had its own homegrown solution. There was little standardization."

Since the internet, which was up and running in September of 1990, things have changed. Says Ziegler, "Our information exchange has entered the '90s."

The main benefit of the internetwork is quick and easy access to the IBM AS/400 located at the head office. It runs two mission critical applications — contract administration and inventory control — as well as several other useful programs, including electronic mail.

The contract administration and inventory control applications are particularly important for the service company. The contract is at the heart of the CDRS business, containing the customer information and the CDRS commitment to provide specific recovery services. When a customer calls, CDRS agents must know exactly what is expected of them, and the contract tells them.



The inventory control system at CDRS is used to keep track of the company's vast array of computer equipment. This equipment is scattered across the continent in all eleven CDRS offices. Since CDRS must be capable of reproducing every customer facility and since customer equipment is always changing, CDRS sites are constantly growing and changing. Just keeping track of what CDRS owns is a major chore.

One of the major challenges for CDRS is continually to match its stated commitment with the equipment available at CDRS sites. In essence, this means matching its contracts with its inventory. When CDRS promises to restore computer services it must be sure it can meet the customer's particular requirements. Given the variety of customer installations, managing the contracts and the inventory is a heavy job.

Before the internet, contract administration and inventory control were done on a site by site basis. Contract changes and inventory updates were done by mail or telephone. Mostly, each office operated on its own.

With the internet and the AS/400, the contract administration and inventory control can be done for the entire company from any location. Users at each site simply log in to the AS/400 as if it were local. The internetwork takes care of the rest.

Armed with the con-

tract and inventory information now available at their fingertips over the internet, CDRS agents throughout the company can better service their customers. They know when it is time to renew a contract, which customers can benefit from one of the company's new services, and what equipment they need to have on hand. Thus, the internet has improved the company's ability to deliver its major product — disaster recovery service.

Another benefit of the internet is its ability to distribute documents from one office to another. Much of the engineering for CDRS site offices is done by an engineering department at the Rosemont headquarters. Schematic drawings, floorplans, equipment layouts, and data center diagrams are made using Computer Aided Design (CAD) tools and then distributed to the sites as necessary. The sites can make their input if necessary, or just sign off on the engineering department's suggestions.

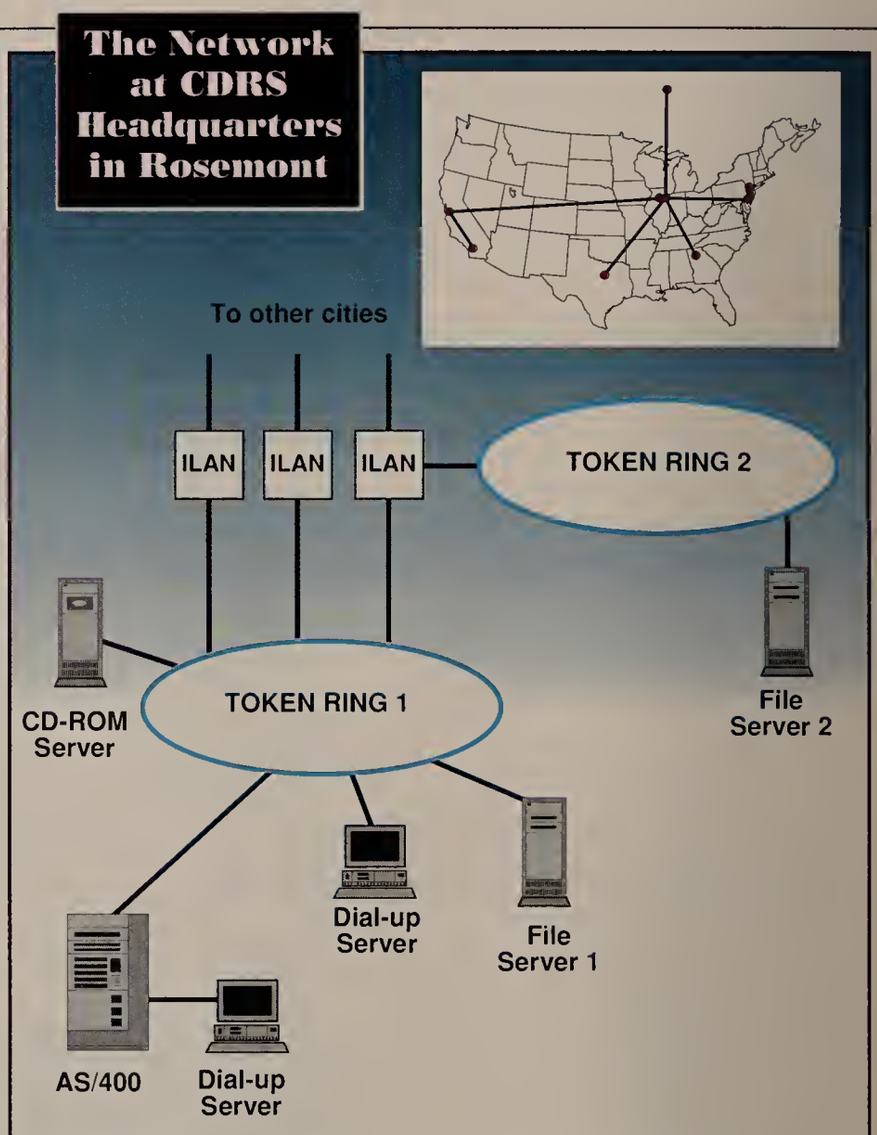
With all the internetwork applications, the internetwork is transparent. Each individual LAN gives its users the feeling they are accessing all resources at their PC. The internet simply extends this feeling across the continent.

The Layout

The CDRS internetwork is composed of eleven Token Ring LANs, two in Rosemont, IL, three in three offices in New Jersey, and one each in San Francisco, Los Angeles, Toronto, Dallas, Atlanta, and Wooddale, IL.

All eleven networks run the NetWare network operating system from Novell (Orem, UT). The networks are connected over long distance 56kbps lines which are leased from a common carrier. Making the connection between the LANs and the wide-area network (WAN) are ILANs from CrossComm Corporation (Marlboro, MA).

The ILANs contain the technology necessary for translating the Token Ring traffic into serial traffic over the leased lines and vice versa. They also make the connection between the two Token Ring LANs at the Rosemont headquarters. The connection is completely transparent to the user. Devices on other LANs appear as if they were local. A user attempting to use a file server on a remote network simply issues the NetWare ATTACH command as if the file server were local. The ILAN devices then take



CDRS Network -- *Above is shown the main Token Ring LAN at Comdisco Disaster Recovery Services headquarters in Rosemont, IL. Like CDRS's eleven other LANs, it has a NetWare file server. Unlike the other LANs, it connects to an AS/400 minimainframe computer that runs the company's contract administration and inventory control applications. It also has a CD-ROM server and an asynchronous dial-up server for remote users not connected to a company LAN. All the LANs, remote and local, are connected using ILAN intelligent routing devices from CrossComm. The configuration of LANs that make up the CDRS corporate network are shown in the inset. The internetwork spans the entire continent, North, South, East and West. The ILAN devices handle both the local inter-LAN connections, as in Rosemont, and the LAN-to-Wide-Area Network connections that interconnect remote LANs. All the connections are transparent to the users, making the entire network seem like one large local LAN. To connect to a file server on another LAN, users simply issue the NetWare login in command with their name, password, and the name of the file server. To access the AS/400, they load terminal emulation software and issue the login command as if they were using a terminal directly attached to the AS/400. The ILAN devices take care of routing those requests.*

care of getting that request to the appropriate network and the appropriate file server.

The same is true for AS/400 users. They load their terminal emulation software at their PC and log on as if they were directly attached. The internetwork passes all communication transparently. So transparently in fact, the delay of long distance transmission is hardly noticeable. AS/400 users have the luxury of being able to run NetWare applications and AS/400 applications simultaneously.

For all networks to be accessible to each other, CDRS has made one of the LANs at Rosemont a backbone ring. Attached to it are three ILANs. Each ILAN has four connections: one for the backbone LAN and three for the leased lines that make up the wide-area network.

Thus, one ILAN has the connections for, say, Atlanta, San Francisco, and Dallas. Another has them for New Jersey. The third has connections to Wooddale, Toronto, and to the second Token Ring at Rosemont. Los Angeles is connected through the network in the San Francisco office in piggy-back fashion.

If two site LANs, say Toronto and Wooddale, are connected to Rosemont via the same ILAN, the traffic between them will pass through the ILAN in Rosemont but it will not be put on the backbone. This increases the performance of the enterprise network as a whole since it segments the traffic. That is, the traffic between Wooddale and Toronto never gets onto the ring because the ILAN device makes the connection between the two networks internally.

Access to piggy-backed sites, such as Los Angeles, is exactly the same as to any other site. The ILANs take care of routing the data from office to office. The total number of ILANs is 13, three for the backbone ring and one each for the ten remote rings. The ILAN in San Francisco interconnects two WAN links (one from Rosemont, one from Los Angeles) and the local Token Ring.

Some Protocol Difficulty

CDRS had little difficulty in putting its internetwork together. The one problem it did have was indicative of the complexities of internetworking in today's heterogeneous world.

CDRS constructed its internetwork in stages. Before the internetwork was connected a Token Ring network was put together in each office. Each LAN was to run the NetWare network operating system. Though the NetWare file servers and workstation software were prepared by the MIS department in Rosemont, a problem arose when the networks were connected via the ILAN devices.

PCs on one network could not find NetWare file servers on other networks. The reason was simple. Each NetWare LAN had been given a different number, yet the ILAN internetworking devices did not understand this number. The problem was not with the ILAN devices, however. It was with NetWare.

Network numbers in the Novell environment are transmitted using the NetWare IPX protocol. This is a proprietary protocol. The only internetworking products on the market that supported this protocol when CDRS was building its network were from Novell. But Novell's internetworking products did not provide other functions that CDRS needed. For example, CDRS needed to support Ethernet and Token Ring remotely, and it needed to support other protocols such as SNA.

The solution was to give every network the same number and use the ILAN internetworking devices. It worked well. All NetWare file servers are completely accessible from all networks. The internetwork is completely transparent to the users.

Note From The Editor: CrossComm's ILANs (software release 4.03 and higher) now offer a feature which solves this problem for internetworks using NetWare. ILAN based enterprise networks no longer require renaming servers if they have been previously installed.

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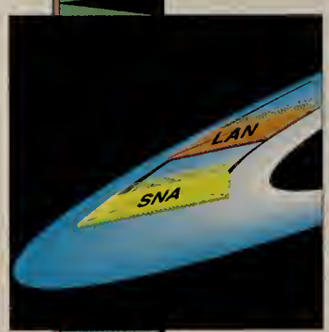

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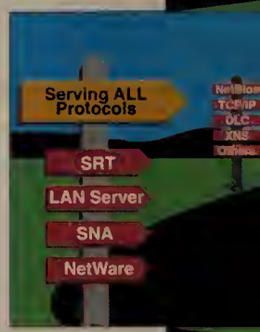

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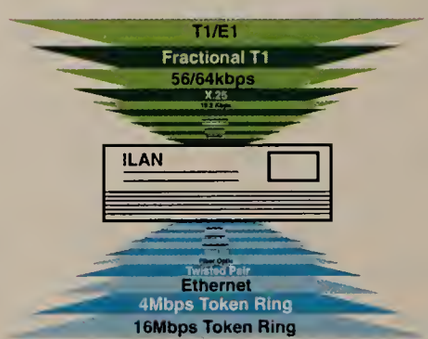

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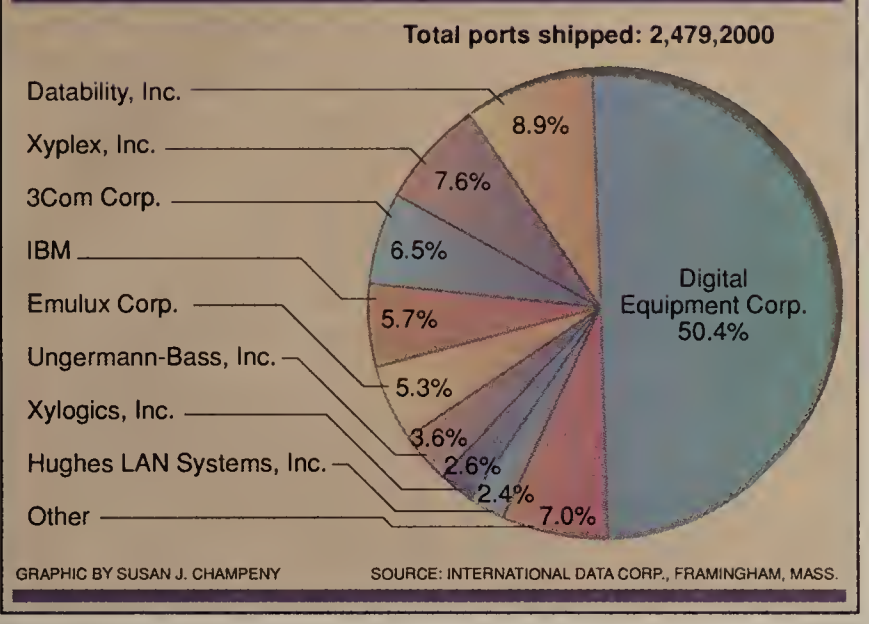
Worth Noting

"If you're looking at OSI from the standpoint of another network that you're adding to your Heinz 57 varieties, the benefit and the value isn't really there."

Laurie Bride
Manager, network architecture
Boeing Computer Services Co.
Seattle

Worldwide terminal server port shipments



Data Packets

Systems Center, Inc. of Reston, Va., last week announced a $1 million agreement with **Comdisco Computing Services Corp.**, based in Carlstadt, N.J., for Systems Center's Network DataMover data transfer software.

Comdisco, a disaster recovery services company, plans to expand its use of Network DataMover, which it has employed since 1987.

Comdisco uses the product to support bulk data transfers between various vendors' computers for functions such as transfer of client data to disaster recovery centers.

Simpact Associates, Inc., located in San Diego, recently announced that its CNS 6000 Series network communications server now supports IBM RISC System/6000 workstations. The CNS 6000 is a programmable local-area network-based server that can be configured to support virtually any proprietary wide-area protocol, according to Simpact.

The server uses the Transmission Control Protocol/Internet Protocol to communicate with RS/6000 and other machines on an Ethernet LAN. That provides those machines with access to the CNS 6000's eight serial ports for wide-area links.

RS/6000 support for the CNS 6000 is available now.

Pricing for the product starts at $7,950.

(continued on page 14)

Wall Data adds TCP/IP, OS/2 support to Rumba

Enhances its line of PC-to-host software tools.

By Paul Desmond
Senior Editor

REDMOND, Wash. — Wall Data, Inc. recently announced a number of additions and enhancements to its Rumba line of personal computer-to-IBM host communications software, including the company's first OS/2 and TCP/IP versions of Rumba.

Wall Data introduced Rumba PM 1.0, which runs on a personal computer under OS/2 and uses IBM's Presentation Manager graphical user interface (GUI). It is the first version of Rumba that works with a GUI other than Microsoft Corp.'s Windows.

Rumba PM includes the same major productivity features as Rumba for Windows.

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The product allows users to simultaneously employ personal computer- and 3270 mainframe-based applications from the same GUI.

Users can cut and paste all or part of any file between host- and personal computer-based applications.

Same type of features

Wall Data said Rumba PM has the same look and feel as previous Windows-based versions, thus allowing companies that employ both Windows and OS/2 on different workstations to develop companywide interface and host connectivity standards.

Rumba PM includes the same major productivity features as Rumba for Windows. The features include Hotlinks, which lets users create links that automatically bring in updated data to OS/2 applications from specified host applications. Another feature is QuickStep, which automates the host access procedure.

Rumba PM works with major network types, including token-ring nets and coaxial cable attachments. Wall Data said it intends to develop Rumba PM support for Novell, Inc. NetWare for SAA and NetWare SNA Gateway.

Scheduled for availability in September, Rumba PM costs $495.

Rumba TN3270 interface

Wall Data also introduced the Rumba TN3270 interface, which lets personal computers attached to Transmission Control Protocol/Internet Protocol-based networks link to IBM mainframes from a Windows user interface. Rumba TN3270 is a new feature included in Rumba 3.1, Wall Data's DOS and Windows-based Rumba products.

The company said the product gives users a way to integrate Systems Network Architecture users into a TCP/IP backbone.

Rumba TN3270 works with mainframe-based TCP/IP Telnet servers to make the personal computer appear as a 3270 terminal to the IBM host. Telnet is the TCP/IP virtual terminal protocol.

Unlike other DOS-based Telnet products that only support a subset of 3270 functions, Rumba

(continued on page 15)

User melds voice/data on fractional T-1 net

Holy Cross Health System counts on big savings from integrating separate data nets, voice traffic.

By Maureen Molloy
Staff Writer

SOUTH BEND, Ind. — Holy Cross Health System (HCHS) recently cut over a fractional T-1 backbone network that replaces two separate data networks and links 13 facilities nationwide to the corporate data center here.

The organization expects the network to save about $15,000 a month in data transmission costs as well as an additional $10,000 per month when compressed voice traffic is added to the backbone — a project scheduled to begin this week.

Combining traffic on access and transport links will enable the company to "save money at each point in the network," said William Anksorus, information resources technical services director at HCHS.

The data networks folded into the fractional T-1 backbone include an IBM System Network Architecture/Synchronous Data Link Control multipoint network, which enables users to access patient information on a mainframe at the company's corporate headquarters, and a multipoint SDLC network, which lets users access an IBM Application System/400 supporting clinical application development.

With the new network, each remote site has full T-1 access to its local central office switch. Newbridge Networks, Inc. Mainstreet 3600 multiplexers are used to combine both types of data traffic and forward it into the AT&T network. From there, the traffic is carried back to the data center via 128K bit/sec AT&T digital facilities.

AT&T has also come under fire for offering 800 services in its Tariff 12 packages.

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A handful of remote sites are attached to the backbone through nearby sites that have backbone nodes.

In the second phase of the installation, tie-line traffic between Rolm Co. private branch exchange switches will be added to the network by feeding it into the

(continued on page 14)

Codex unveils V.32 dial-up modem for its 3200 series

By Paul Desmond
Senior Editor

MANSFIELD, Mass. — Motorola Codex last week introduced a new desktop member of its 3200 Series of high-speed dial-up modems as well as a single-line dial-up restoral feature for its leased-line modems and data service unit/channel service units (DSU/CSU).

The new 3220 modem is a CCITT V.32-compatible dial-up modem that rounds out the low end of Motorola Codex's 3200 modem family.

3220 support

The 3220 supports both synchronous and asynchronous communications over two-wire dial-up links as well as transmission speeds from 300 to 9.6K bit/sec. It also supports Microcom Network Protocol Class 5 data compression, which can boost effective asynchronous throughput to 19.2K bit/sec.

Tom Hayes, director of marketing for transmission products at Motorola Codex, said the 3220 will appeal to corporate users because it comes with a two-year warranty, a guarantee that a replacement modem will be shipped within 24 hours of a reported failure and a toll-free technical hot line manned around the clock. In addition, the company estimates the mean time between failures for the 3220 is about 17 years, Hayes said.

The 3220 is the first desktop model in the 3200 Series, which includes eight other leased and dial modems. Available now, the 3220 costs $750.

Motorola Codex also last week

(continued on page 14)

Codex unveils dial-up modem

continued from page 13

announced a feature for its leased-line modems and DSU/CSUs that lets users restore a lost circuit using a single dial-up link.

> "You do take a bit of a hit in speed, but most users can deal with that for the savings."
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The Single Line Restoral feature uses Motorola Codex's core V.32/V.32bis technology to support backup transmission speeds of up to 14.4K bit/sec, as opposed to speeds of 24K bit/sec that can be achieved using the more typical dual-line dial restoral. Although the speed that can be achieved is lower than what is possible using two lines, single-line backup can mean cost savings of $1,200 to $1,500 per link annually, the company estimates.

"You do take a bit of a hit in speed, but most users can deal with that for the savings," Hayes said.

Single Line Restoral is already shipping with the 3600 Series Communications Platform, as the company promised it would when the combination modem/DSU was announced last year. Current 3600 users can purchase a software upgrade that supports the feature for $860.

Support for Single Line Restoral on the 3300 Series of leased-line modems was announced last week and is currently shipping. Prices for modems equipped with the feature range from $2,495 for the 3340 9.6K/14.4K bit/sec modem to $4,145 for the 3380, a 19.2K bit/sec modem.

The feature is also available as an external device for the 3500 Series DSU/CSU. Those products include an internal A/B switch that can trigger the use of any external restoral device, such as a V.32 modem, in case the primary leased line fails.

The 3500 Series network-managed DSU/CSU with restoral is priced at $2,265.

Users meld voice/data

continued from page 13

multiplexers. The Newbridge boxes will compress the traffic into 16K bit/sec channels for transport across the 128K bit/sec backbone.

"With voice compression, rather than require a full DS0 for a voice circuit, we can multiplex a DS0 into four voice circuits," Anksorus said.

He said Newbridge equipment supports a virtual multidrop overlay that allows remote sites or terminals to be positioned anywhere in the network, regardless of differences in the physical topology.

"Since T-1 is primarily point to point, Newbridge threw software on each of the nodes to cross-connect circuits and make it appear as a contiguous circuit throughout the network, making it look like a typical IBM multipoint circuit," he said.

The remote sites use Newbridge Digital Termination Units to collect terminal data, which is then transmitted to each site's multiplexer over a single twisted pair using Integrated Services Digital Network Basic Rate Interface loop technology.

Anksorus said a future application may include the implementation of a 384K bit/sec switched videoconferencing network that would support all 13 facilities.

"Since we have both fractional and full T-1 capability, we'll have the equipment in place to handle future videoconferencing applications," he said.

Data Packets

continued from page 13

IBM recently announced a line of rugged, notebook-size, battery-operated personal computers that are equipped with internal modems that enable the device to transmit data over radio, cellular or conventional telephone lines.

IBM's new DOS-based 9075 PCradio is intended for users such as service technicians, police departments and sales representatives, who often need to send and receive data from remote locations.

The PCradio uses a 5-MHz to 10-MHz Intel Corp. 80C186 microprocessor and has 640K bytes of random-access memory.

Pending Federal Communications Commission approval, IBM will offer three models of the PCradio that are differentiated by the type of internal modem provided.

The Model 001 has a conventional modem that works with telephone lines at up to 2,400 bit/sec. Model 002 has a Motorola, Inc. 4.8K bit/sec radio frequency modem that works with radio networks such as ARDIS, a network owned by IBM and Motorola. The Model 003 has a 4.8K bit/sec cellular modem.

Models 002 and 003 can also be used with terrestrial telephone networks.

The PCradio comes equipped with a 25-line display that shows 80 characters per line. Also, it can send or receive facsimile copies over cellular or terrestrial networks.

An integrated 3⅛-in. thermal printer is optional.

The product is scheduled for availability in the fourth quarter. Pricing is not finalized due to pending FCC approval. But IBM said its target price for single units is $5,500 for the radio and cellular models, and $3,100 for the telephone model.

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Wall Data adds to Rumba

continued from page 13

TN3270 supports full 3270 functionality while the Windows interface makes the product easier to use than traditional Telnet packages.

Rumba 3.1 works with a range of connection types, including coaxial cable adapters, IBM or compatible Synchronous Data Link Control adapters, a channel-attached non-SNA 3174 interface, front-end processor connected token-ring local-area networks and Rumba Remote asynchronous dial-up.

In addition, Rumba 3.1 works with a range of popular SNA gateways.

Scheduled for availability in September, the Rumba TN3270 interface is provided at no extra cost with Rumba 3.1, which has a license fee of $495.

Rumba for AS/400

Wall Data also announced it will begin worldwide distribution of Rumba for AS/400, which the company originally developed for IBM and is sold by IBM as Rumba/400.

The product enables personal computers running Windows to access and use data stored in an IBM Application System/400 minicomputer along with personal computer-based applications.

Wall Data also unveiled an enhancement to Rumba for AS/400, dubbed the Rumba for 3270 Feature.

The addition lets Rumba for AS/400 users simultaneously access applications on an AS/400 minicomputer and an IBM mainframe from the same Windows interface.

As with the other Rumba products, users can cut and paste between mainframe and minicomputer applications.

Scheduled for availability in September, existing Rumba for AS/400 or Rumba/400 users can add the Rumba for 3270 Feature for $200.

Wall Data also announced it will begin worldwide distribution of Rumba for AS/400.

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Microcom exec optimistic

continued from page 7

capabilities to its bridges by year end.

"By the end of the year, there won't be any distinction between bridges and routers. All routers will have improved bridging capabilities, and all bridges will have routing capabilities," he said.

Microcom will also continue to enhance and expand its modem business, which accounts for about half of the company's annual revenue. Software contributes about 30% of revenue, and internetworking products generate about 20% of revenue.

Microcom expanded its modem line in April with the introduction of its MicroPorte family of V.42bis portable modems, which are designed to work with portable computers and can handle poor quality lines for data communications, such as cellular circuits. More products in this area are planned down the road, he added.

Microcom will also continue to improve its software offerings by unveiling a Windows version of its Carbon Copy software packages in the fall, a company spokesman said.

One area that Dow revealed Microcom is no longer championing is Integrated Services Digital Network. Microcom was an early adopter of ISDN, supporting a Basic Rate Interface on its MLB 5500 bridge.

"We really reduced our investment in ISDN," he said. "The market does not appear to be developing in the U.S. I don't know if it will ever happen — I think frame relay is going to take away a lot of applications ISDN would have handled." Microcom plans to implement frame relay into its products, Dow said.

Meanwhile, the company remains cautiously optimistic, he said. "Maybe after three more good quarters, we'll throw a turnaround party."

Few products make registry

continued from page 7

has garnered praise from users in the private sector, has not yet passed conformance tests.

Using its own accredited lab facilities, HP has spotted a few defects in the HP FTAM/9000 product after running 1,000 test cases, but the company is confident the testing will be successfully completed by year end.

"We discovered problems with the test tools," which HP brought to the attention of its test systems supplier, Subbarao said.

U.S. vendors and NIST both acknowledge that better abstract test suites and testing systems need to be developed for OSI. Last year, NIST gave only provisional approval to the OSI testing systems used in the GOSIP conformance test program due to underlying weaknesses of the abstract test suites (see "NIST falters in GOSIP test development," *NW,* Sept. 3, 1990).

But in a sign that U.S. vendors and NIST are trying to develop better conformance test methods, Subbarao said NIST has started a new Open Systems Implementors Workshop for conformance testing, which will hold its first meeting Sept. 1 with HP chairing.

In October, NIST plans to make the contents of its registration service more accessible to users by introducing a dial-up data base of information on products.

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All entries must be submitted by Thursday, Sept. 12.

1. Name: _____ Address: _____

Title: _____ _____

Company name: _____ Phone number: _____

2. Abstract: _____

NETWORK WORLD

Worth Noting

According to a recent study by International Data Corp. (IDC), just over 27% of all personal computers are supported by local-area networks. IDC, based in Framingham, Mass., expects that number to rise to almost 40% by the end of the year.

Netnotes

Artisoft Corp. recently announced the Peer-Hub 10-Base-T hub/concentrator, a board-level Ethernet hub that fits into any IBM Personal Computer, XT, AT or Extended Industry Standard Architecture machine.

The hub has five external 10Base-T ports and can be used in the host microcomputer with the firm's AE-3 Ethernet adapter or its AE-1/1 10Base-T Ethernet adapter without taking up a hub port. The devices are linked internally.

As many as four Peer-Hub concentrators can be linked to form a larger hub supporting up to 20 connections. The hub also comes with net management software that will let users monitor the status of ports and activate or disable ports on a port-by-port basis. Scheduled for release next month, the Peer-Hub will cost $399.

LANNET Data Communications in Tarzana, Calif., recently announced the release of a new token-ring fiber-optic repeater module for its Multinet modular smart hub. The module will enable users to run a fiber-optic link between hubs at distances as far as 1.9 miles.

The LANNET LTR-F module comes in two versions: the LTR-F/16, a switchable device that supports local-area network speeds of 4M or 16M bit/sec, and the LTR-F4, which can only be used with 4M bit/sec nets. Both versions are available now. The LANNET LTR-F/16 costs $1,495, and the LTR-F/4 costs $1,095.

Amex unit installs LANs to contend with growth

Burgeoning company tripled in size in four years.

By Timothy O'Brien
West Coast Bureau Chief

OMAHA, Neb. — American Express Information Services Corp. (ISC) recently installed a number of internetworked LANs to support new payroll, human resources and benefits applications and to interface to an outside time-sharing payroll service.

Acquisitions that tripled the company's size to $1.3 billion in four years forced ISC to abandon an inflexible mainframe in favor of more decentralized systems that could accommodate the diverse personnel requirements of the newly acquired businesses.

"It became clear that we had to change the way the business was done," said Ken Dick, director of management information systems at ISC. "The old system was made to fit one company, and we had to respond to the different needs of each business unit."

The company, which provides information processing services for many credit card operations, has 22 locations and employs 20,000 people.

Faced with the need to expand its IBM 3083 mainframe system to meet its growing human resources requirements, ISC began in 1990 to look at local-area network-based software as an alternative to the host.

What it found was a package from data base vendor Revelation Technologies, Inc. in use at one of its acquired business units that exceeded the capabilities of its mainframe software.

The company turned instead, however, to a product called Repertoire offered by Control Data Corp. (CDC) since it was based on the Revelation data base already in use and provided an interface to CDC's mainframe based Signature Payroll service.

> "It became clear that we had to change the way the business was done."
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The firm wanted to offload payroll processing to a third party because it was getting difficult to meet the various demands of the acquired companies with its

(continued on page 18)

New server offers high-end technology at PC-class price

By Caryn Gillooly
Senior Editor

MILPITAS, Calif. — NetFRAME Systems, Inc. last week introduced an entry-level version of its multiprocessor superserver.

The new server, called the NF100ES, will give users the same fault tolerance, data integrity and performance NetFRAME offers with its higher end superservers at the price of more traditional personal computer servers, according to the company, based here.

"In essence, we've taken the NetFRAME technology and packaged it with a different disk subsystem, putting it into a price point relative to a PC-class server," said Tom Glassanos, director of product marketing at NetFRAME.

The NF100ES comes equipped with three processors — one Intel Corp. 8088 and two Intel 80386 chips — and can accommodate as many as five 386 chips. According to the company, the NF100ES supports both Novell, Inc. NetWare and Microsoft Corp. LAN Manager.

The primary difference between the NF100ES and more powerful models in the NetFRAME line is in disk storage capacity and performance, Glassanos explained. The NF100ES comes with a 200M-byte drive, while the company's other servers come with 380M-byte drives. Storage can be expanded to 30G bytes.

The NF100ES drive also has a slower average disk access speed, resulting in about a 20% performance difference in data retrieval time.

Glassanos pointed out, however, that the throughput of the entry-level system is virtually identical to that of other, higher end models.

The new server, which is available now, costs $12,950.

Pros and cons of client/server tools

Tools	Pros	Cons	Ideal usage
Face-lifting tools	Leverage investment in existing code. Cater to expert programmer skills.	Provide limited ability to add client-resident functionality. Are slaves to mainframe application. Require increased maintenance.	With time-shared applications that will not be rewritten for a long time. As a first step into client/server.
Desktop extension tools	Enable desktop users to stay on familiar ground. Provide low cost and ease of implementation.	Restrict application to particular interface. Limit performance.	When need is primarily for data retrieval. When power users act as local support.
Greenfield tools	Allow maximum power and flexibility. Are designed for client/server from the ground up.	Require a new-world mentality and skills in development group. Have higher up-front costs.	When company is fully committed to client/server. When new application is business-critical.

GRAPHIC BY SUSAN J. CHAMPENY — SOURCE: FORRESTER RESEARCH, INC., CAMBRIDGE, MASS.

Development tools address client/server

Present application development tools are lacking, but future generations will smooth the migration.

By Caryn Gillooly
Senior Editor

CAMBRIDGE, Mass. — There are few software products available today to help users build client/server applications, and the tools that do exist are complicated and require expert programming.

But that may soon change, according to a recent study by Forrester Research, Inc., based here. Forrester predicts that three categories of tools will emerge during the next five years that will help Fortune 1,000 firms more easily migrate to client/server environments. The categories include what Forrester calls face-lifters, desktop extension tools and greenfield development tools.

Face-lifters enable users to improve existing host-based applications by making it possible to off-load screen generation responsibilities to client workstations, while desktop extension tools will let existing personal computer applications act as clients for data base servers.

Greenfield tools, so named because they presume the user is starting with a clear, green field, will help users create true client/server applications from the ground up.

The lack of development tools and understanding has stalled the acceptance of client/server technology, according to the study.

"Vendors [of existing client/server tools] have done a miserable job of communicating what their products actually do," said Stuart Woodring, senior analyst at Forrester and coauthor of the report. "As a result, the tools that have appeared over the last year — some of which are pretty good — have not been widely accepted among the Fortune 1,000."

A nip and tuck

The first class of development tools users will accept will be the face-lifters. Today's face-lifters are such products as Easel from Easel Corp., Choreographer from Guidance Technologies, Applications Manager from Intelligent Environments, Inc., Mozart from Mozart Systems Corp., InFront from Multi Soft, Inc. and Flashpoint from Viewpoint Systems.

Face-lifters will make it possible to give programs such as IBM's CICS a new graphical user interface that will make these applications easier to use and more appealing to users, while at the same time help users begin the slow migration toward client/server applications.

According to the study, the advantages of face-lifters include leveraging the installed base of host-based applications and combining multiple applications into a single screen. Disadvantages, however, include performance penalties, as face-lifters communicate with the host through terminal emulation.

For some, face-lifters will only serve as a short-term solution. "If the user wants to take the next step to a real client/server imple-

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Development tools address client/server

continued from page 17

mentation and move the application off the mainframe, [the user] must start anew," the study stated. "Little of the face-lifted front end can be recycled."

Beyond the tuck

For users where face-lifting is not enough, desktop extension tools will be the best solution. These will enable existing desktop applications to act as clients to back-end server data bases.

Examples of these include Lotus Development Corp.'s DataLens, which lets Lotus 1-2-3 users access a variety of SQL-based remote data bases from companies such as Ingres Corp., Informix Software, Inc., Oracle Corp. and Sybase, Inc.; Oracle for Windows, which lets Windows/dynamic data exchange applications access Oracle data bases; and tools for personal computer data bases such as Borland International, Inc.'s Paradox SQL Link that allows access to SQL data bases.

One of the primary advantages of desktop extension tools is their ease of use. According to the study, these tools "let companies implement client/server without disrupting the way end users work. They will continue to relate to information through 1-2-3, Paradox and WordPerfect Corp.'s WordPerfect [or other applications that] run on their desktop."

Like face-lifters, however, desktop extension tools will also degrade performance because the tools must "conform to the quirks of the desktop application," the study stated. In addition, they are not very flexible because they only work with specific desktop applications.

Greenfield tools

For companies that might have applications tailored to their specific business needs, the only alternative may be to build local-area network-based client/server applications from the ground up.

These front-end applications will be written using: object-oriented programming languages such as C++; tool sets offered by server data base companies such as Sybase, Oracle, GUPTA Technologies, Inc. and others; or data base vendor-independent tools such as PowerBuilder from Powersoft Corp. and Ellipse from Cooperative Solutions, Inc.

These tools will offer the flexibility and increased performance not available through the other tools but will be complex to develop, according to the study.

Time line

Forrester predicts that between now and the end of 1992, the majority of companies will choose to use face-lifting tools and that market will grow from a current $60 million market to about $100 million.

> "The Fortune 1,000 will embrace face-lifting — it's the easy, low-risk way of trying out client/server," Woodring said.
>
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In the next phase, from the start of 1993 to the end of 1994, vendors will push greenfield tools, which will cause that market to explode.

But because of their complexity, users will be turned off by greenfield tools, and Forrester predicts that by year-end 1994, the first booming market will stall, ending up at about $250 million.

In the final phase, from the start of 1995 on, users will find that desktop extensions will fill a majority of their needs, so most companies will choose this route.

"For the next two years, the Fortune 1,000 will primarily embrace face-lifting — it's the easy, low-risk way of trying out client/server," Woodring said. "Vendors will then push greenfield tools, followed by a strong user move to desktop extension tools.

"By 1996, about 60% of client/server applications will be desktop extensions, 25% will be face-lifts and 15% will be greenfield applications," he concluded.

Unit installs LANs to contend with growth

continued from page 17

existing mainframe payroll application. Dick said outsourcing payroll was also cheaper than doing it in-house.

In addition, ISC used consulting groups to develop interfaces from Repertoire to new LAN-based applications for 401(k), pension and benefit plans from SBC Systems Corp.

Network support

ISC has installed nine networks to support the human resources applications. The token-ring LANs are based on Novell, Inc.'s NetWare and use IBM Personal System/2 Model 80s as file servers. The servers are outfitted with as much as 1.2 gigabytes of storage.

Currently, the only wide-area links between the LANs and personal computers at the 22 ISC locations are 9.6K bit/sec dial-up lines.

In addition, cc:Mail from Lotus Development Corp. is used for electronic mail and to exchange data among the various sites.

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Dialogue

Do you now use — or plan on using — the Simple Network Management Protocol (SNMP)?

"We don't use it now, but it's something we're very interested in for the future.

"We currently run TCP/IP over our Ethernet. We haven't zeroed in on a network management system yet because we're in the middle of a major network restructuring project. But when we do, SNMP may be the system we choose."

Mel Moulton
Network planner
Rockwell International Corp.
Dallas

"Yes. Our goal is to convert everything to TCP/IP, and we're moving more and more to an SNMP network management system. Achieving the proper connectivity between buildings isn't easy, so we're trying to set standards that all the systems can adhere to as we build our backbone. TCP/IP and SNMP represent widely accepted standards that we can feel comfortable latching onto."

Robert Bursick
Director of telecommunications
Wayne State University
Detroit

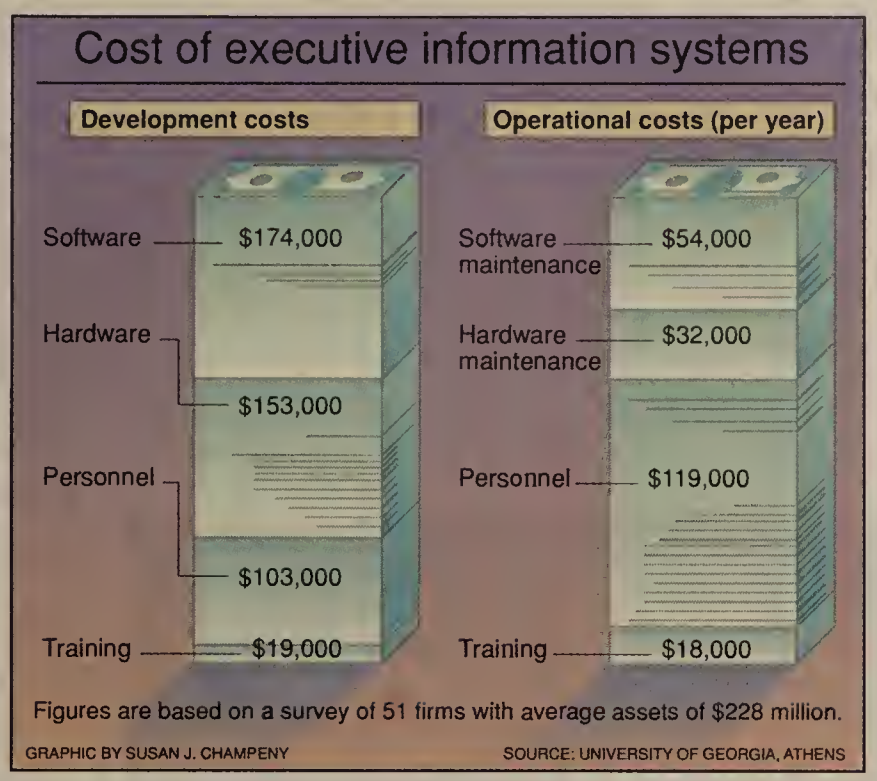
"We're looking to migrate everything to the OSI standard networking model. TCP/IP and SNMP are [important] in this area and we intend to move to them as an interim step before OSI.

"We have a large TCP/IP network and are looking at SNMP to manage this environment. We also have NetView supporting our large SNA network, but there are a number of non-SNA devices on the network that don't support NetView."

Gerard Monday
Manager of corporate information systems
J.C. Penney Company, Inc.
Dallas

"Yes. We have a large Unix network with several thousand nodes attached, and we use SNMP extensively. It provides the minimum network management capabilities while we await the availability of a more robust standard in the future."

Ira Morrow
Vice-president of technical planning
Shearson Lehman Brothers, Inc.
New York



Executive info systems are moving from hosts to LANs

Study portrays technology's evolution since 1988.

By Wayne Eckerson
Senior Editor

ATHENS, Ga. — Companies are increasingly implementing executive information systems (EIS) on personal computers and local-area networks rather than mainframes, according to a new study.

The study also found that many companies that implement EIS fail on their first attempt because senior executives resist using the new technology or the system does not meet their needs.

> The biggest reason behind the move to LAN-based EIS is speed, according to Watson.
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Titled "Executive Information Systems: An On-Going Study of Current Practices," the report is based on interviews with EIS managers at 51 companies in a variety of industries.

The same survey was conducted in 1988, and the current study compares the results of the two.

An EIS provides top executives with customized summaries of key business indicators culled from a variety of data sources inside the company. In addition, EIS usually incorporate electronic messaging and provide electronic access to external data sources, such as on-line news services.

According to the study, the number of firms using a LAN-based EIS has nearly doubled since 1988, while the number of mainframe-based EIS has dropped considerably.

The percentage of companies using LAN-based EIS has jumped from 17% in 1988 to 31% in 1991.

At the same time, use of mainframe-based EIS dropped from 83% to 61%. The study also showed that 8% of companies run an EIS off stand-alone personal computers.

The biggest reason behind the move to LAN-based EIS is speed, according to Hugh Watson, professor of management information systems at the University of Georgia here and one of the study's three authors. The other two are R. Kelly Rainer, assistant professor of management systems at Auburn University in Auburn, Ala., and Mark Frolick of Memphis State University in Memphis, Tenn.

"Personal computer networks are faster, which is important because executives aren't tolerant of slow response times," Watson said. "Using a mainframe can be a crapshoot because response times can vary according to the amount of processing the mainframe is doing at any one time."

The study also showed that companies are migrating EIS to LANs because LAN-based systems are less expensive and easier to implement and operate.

Watson said EIS vendors will soon begin offering products that are based on a three-tiered data architecture in which EIS data is distributed among a mainframe,

(continued on page 20)

Lack of tools hinders usage-based billing

Network managers seeking better cost recovery methods to streamline budgets, improve services.

By Maureen Molloy
Staff Writer

A growing number of network executives are looking to implement accounting systems that charge end users based on actual usage of voice and data networks, but they say few tools are available to help them implement such chargeback systems.

Many network departments currently charge other business units a fixed overhead fee for network usage. But some net managers are trying to establish systems that provide more precise network usage data in order to get a better handle on costs and improve network efficiency.

"The goal of most cost recovery schemes is to charge end users for the real cost of providing service. It encourages the best economic decisions and doesn't leave one group subsidizing the service of another," said Dell Fischer, corporate telecommunications manager at Hewlett-Packard Co. in Palo Alto, Calif.

But while usage-based chargeback is ideal, most managers say it is too difficult and costly to implement as a real-world cost recovery solution.

Gary Henkel, director of telecommunications at Time Customer Service, Inc. in Tampa, Fla., considered implementing a usage-based accounting system but determined that precise tracking and billing of voice and data network usage would be too cumbersome.

"We decided it just wasn't worth the effort. There's very few off-the-shelf products available, and we'd be left having to develop the entire system internally," Henkel said. "The burden and cost of implementing it would cancel the benefits of doing so."

Eric Schmall, a network manager for an insurance holding firm, agreed that the administrative headaches involved in a usage-based chargeback system are legion.

"The [net] manager finds an increasing amount of his time devoted to adjudicating what is 'fair' in terms of chargebacks as the [usage] function evolves," Schmall said. "Few management tasks can rival the exasperating trials of arguing with confused users about the proper way expenses should be rebilled."

Kathleen Barret, director of network services at Real Decisions Corp., a Darien, Conn.-based consultancy that provides

(continued on page 20)

EXECUTIVE BRIEFS

BY WAYNE ECKERSON

AI job bank opened. The International Association of Knowledge Engineers (IAKE) has established an on-line job bank that matches specialists in artificial intelligence with potential employers around the world. The IAKE Job Bank posts resumes of engineers who design and build AI-based computer systems and lists job openings at corporations, universities and government agencies.

IAKE, a nonprofit organization that defines and standardizes qualifications for knowledge engineers, has members in 42 countries. Both members and nonmembers can register with the job bank by dialing into the IAKE bulletin board at (301) 816-2473. For more information, call Joi Goodman at (301) 231-7826.

Carrier opens fourth demo center. US Sprint Communications Co. recently opened a product demonstration center in San Mateo, Calif., near the San Francisco International Airport that will showcase the carrier's latest technology offerings, including high-speed data applications, worldwide videoconferencing, electronic messaging and Integrated Services Digital Network services. This is the fourth such center US Sprint has opened. The other three are located in Atlanta, Kansas City, Mo., and Washington, D.C.

Executive IS moving from hosts to LANs

continued from page 19

network servers and client workstations. In this configuration, the mainframe will serve as a repository for all EIS data, the network server stores screen-generation software and data commonly used by a work group, and client workstations store data used by individual users.

A failed cause

Despite the growing sophistication of EIS, many companies indicated their initial efforts to implement EIS failed. By failure, companies meant the EIS was not being used, was dismantled or was being used by people other than the target group of executives.

According to the 1991 survey, 34% of the respondents said their first attempt to implement an EIS failed. In 1988, 38% said they were unsuccessful in implementing an EIS.

According to Watson, these failures were usually a result of poor software selection or an attempt by a firm to develop an EIS in-house or substitute a decision support system for an EIS.

He also said EIS can fail because senior executives are not committed to the project, the EIS does not meet their needs or executives are unwilling to use new technology.

In addition, the study showed that:

- The costs of developing and supporting EIS have increased since 1988. Software accounts for the greatest expense when developing EIS, and personnel is the largest expense in supporting EIS (see graphic, page 19). The average cost of developing an EIS is nearly $450,000, which includes software, hardware, personnel and training. The average cost of operating an EIS is $223,000 a year.
- It takes an average of 4.1 people to develop the EIS and 3.5 workers to support it.
- More firms are now using commercially available EIS software than in the past. In 1988, only 24% of the firms surveyed used vendor-supplied software. More than 53% now use commercially available software.
- Smaller firms are now implementing EIS. Firms using EIS in 1988 averaged $5.37 billion in assets. Companies using EIS today have an average of $288 million in assets.
- Executives are now more likely to initiate EIS development than in the past. In 1991, executives initiated EIS development in 86% of the firms surveyed. In contrast, only 68% of executives initiated EIS development in 1988.
- Companies take an average of 3.4 months to develop an initial version of EIS.
- Most EIS are developed for a small number of users (9.5) but are later expanded to support additional people, sometimes as many as 150.

For more information on the survey, call Watson at (404) 542-3744.

Lack of tools hinders usage-based billing

continued from page 19

benchmarking services, recommends that net managers stick with the traditional fixed-cost method until better billing tools for network cost recovery become available.

"Many managers are running their networks more like a business and want to start charging customers based on actual usage, but it's just not a practical method yet," she said.

Despite the problems inherent in migrating from a fixed to a usage-based chargeback system, some users are still plugging ahead. David McKinney, supervisor of telecommunications at Bendix/King in Olathe, Kan., is currently building a customized billing system for voice and data.

> "Users are more careful about how they use the net when costs come directly out of their departmental budget."
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"I'm a believer in a usage-based system because it's a good check that network resources are being used wisely," he said. "Users are more careful about how they use the net when costs come directly out of their departmental budget."

HP's Fischer agreed. HP charges departments on actual usage of its wide-area network, but the chargeback system hasn't been an easy sell. "There's been conflict because the user wants a fixed cost but the manager wants people to use the service wisely and be charged for the actual cost of use," he said.

According to Fischer, he was able to more easily justify the new system to users by developing a rate structure similar to that of the interexchange carriers. He charges for use of common network resources, such as a T-1 backbone line, based on the number of kilocharacters transmitted — a similar method to what is used by the value-added public networks.

Although the billing system was a significant development task, Fischer said it has been worth the effort.

"It's been a huge investment, but it's worth it for a company of our size because we've been able to achieve some economies of scale with this system," he said.

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World News

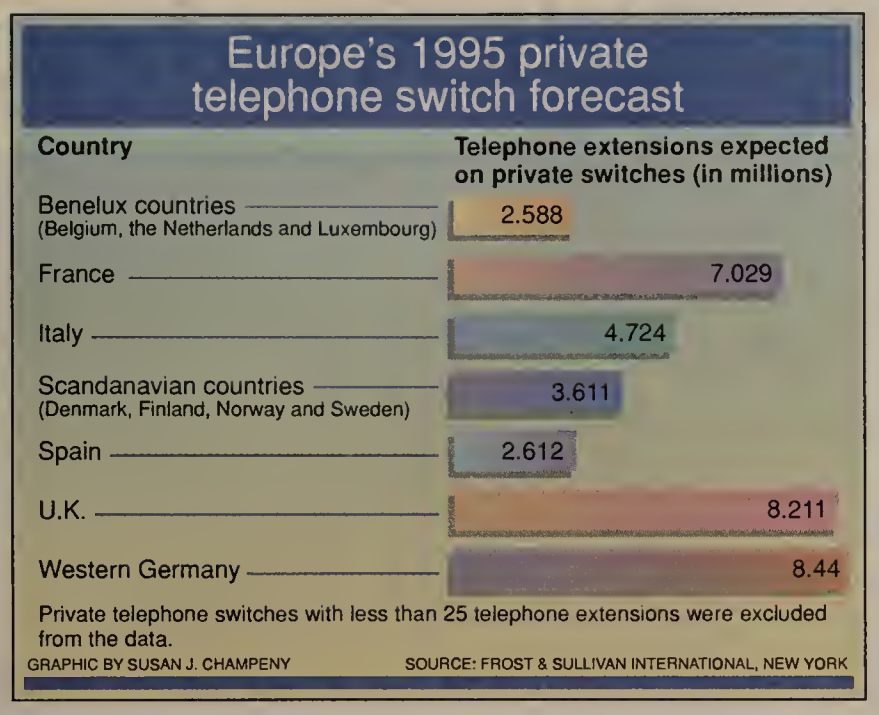
US Sprint Communications Co. last week said it has opened local access nodes for its SprintNet international value-added network in Australia, Belgium, Guam, Hong Kong, Italy and Norway.

Additionally, the carrier said it has opened X.75 gateways between SprintNet and public X.25 packet-switching networks in China and Kenya. The X.75 gateways enable users of public packet networks in those two countries to send data to users of SprintNet and vice versa.

Satellite communications equipment vendor **Scientific Atlanta, Inc.** last week said it won a $4 million contract to supply a private very small aperture terminal satellite network to Banca Serfin, which is owned by the Mexican government. Scientific Atlanta said the VSAT net will be one of the largest in Latin America.

The VSAT network will link Banca Serfin's Mexico City headquarters and four regional offices to 172 branches throughout Mexico. The net will replace dial-up links and support automated teller machine and remote data base access transactions.

The **International Telecommunications Satellite Organization** recently launched the fourth of its INTELSAT VI series of satellites. The new satellite has 38 C-band and 10 Ku-band transponders that can carry up to 120,000 telephone calls and three color television channels simultaneously.



British Telecom to launch voice mail in Hong Kong

Gets little competition from traditional competitors.

By Don Tennant
IDG News Service

HONG KONG — British Telecommunications, PLC appears to be running a one-man race to introduce voice messaging service here as local rivals Hong Kong Telecom CSL and Hutchison AT&T Network Services (HANS) are nowhere to be found.

Although voice messaging services are widely used in the U.S. and U.K., they have been unavailable in Hong Kong since Hong Kong Telecom dropped its relatively low-tech version of the service some years back due to a lack of customer response.

When HANS was formed last month as a joint venture of Hutchison Telecom and AT&T Hong Kong, it introduced a package of messaging services based on AT&T's Easylink technology, but voice messaging was not included in the bundle.

But British Telecom is convinced the voice mail market will develop here.

"We believe voice messaging has even greater potential value for businesses in this region," said Peter Nelson, managing director of British Telecom's Hong Kong unit.

He said such services are particularly useful for multinational companies that have frequent dealings with the U.S. and Europe, and need to overcome time differences when trying to contact the right person at the right time.

"You can access your voice mailbox from any phone, fixed or mobile, in any country and at any time of day," Nelson said. "While fax and electronic mail can handle data very efficiently, the spoken word is a far more powerful way of conveying intentions as well as information."

Another advantage, he said, is that, unlike conventional phone answering systems, voice messaging does not require users to purchase or maintain special

(continued on page 24)

Net lets firm unify sales offices abroad

Hybrid private-line/X.25 packet network enables Analog Devices to do away with separate systems.

By Barton Crockett
Senior Editor

NORWOOD, Mass. — Analog Devices, Inc., a half-billion-dollar semiconductor maker here, is installing a European network that will enable it to replace separate data processing systems with a centralized system the company acquired in a recent merger.

Analog Devices' new hybrid network will use both private lines and public X.25 packet switching services to route financial and customer order data from more than 10 European sales offices to a minicomputer in Zug, Switzerland.

Although the minicomputer is owned by Analog Devices, it is housed at the headquarters of semiconductor maker Bourns, Inc. Analog Devices recently acquired Bourns' Precision Monolithics, Inc. division as well as a copy of the financial and order-entry software Bourns uses to support its European sales offices.

According to Chris Brown, Analog Devices' corporate telecommunications manager, the firm will save millions of dollars in administrative and personnel expenses by using the net to enable European offices to access the centralized system in Zug. Analog Devices will do away with the stand-alone systems those offices currently use.

"Our network is driven by our desire to become much more efficient," he said. "I don't think we could do what we're doing and achieve reductions in expense levels without the network."

Brown declined to detail how much money Analog Devices expects to save. The company made about 30% of its $485 million in sales last year in Europe.

Software deemed best

Analog Devices had wanted to upgrade the financial and order-entry software in its European offices for more than a year, according to Brown. He said the company considered buying or designing its own software but concluded it was more economical to buy a copy of Bourns' software. Analog Devices bought the software as part of its acquisition of Precision Monolithics in August 1990.

> "Our network is driven by our desire to become much more efficient," Brown said.
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The company has been phasing in the new European network on a step-by-step basis. Shortly after acquiring Precision Monolithics, the company gave its European sales offices dial-up, X.25 access via BT North America Inc.'s Tymnet international value-added network to Bourns' financial and order-entry system in Zug.

If necessary, data could also then be routed from Zug over Bourns' private network to Precision Monolithics' headquarters in

(continued on page 24)

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Firm unifies offices abroad

continued from page 21

Santa Clara, Calif.

In October, Analog Devices ordered dedicated 9.6K bit/sec Tymnet access lines for its European sales offices to replace the dial-up links. It took eight months for the lines to be installed. The first dedicated link was installed in the Netherlands last December, while the final link was installed this May in Italy.

Flat-rate charge

Brown said the firm is paying a flat rate of $1,800 per month per office to send data from remote offices over the Tymnet network to the host in Zug.

In June, Analog Devices got its own minicomputer up and running in Zug with a copy of Bourns' financial and order-entry software. The company then began shutting down the sales office's financial and order-entry systems.

Last week, Analog Devices cut over a 64K bit/sec private line linking a network hub in the U.K. with the host in Zug, Brown said. The U.K. hub is also linked into the company's global private network.

This link enables the Zug host to communicate with Analog Devices' hosts here without having to transit Bourns' private network. This gives the company end-to-end control of its data.

Additionally, Analog Devices' European sales offices can use Tymnet to access the U.K. hub. This enables them to directly access data on the company's corporate hosts at Analog Devices' headquarters in Massachusetts.

Brown said one reason that Analog Devices chose Tymnet is because the net's nodes are close to Analog Devices' offices. But recent network reliability problems may force the company to reevaluate this choice.

For example, the Tymnet link in Switzerland was down for two days recently. Managers in the European offices are questioning whether the Tymnet service is adequate to meet their needs, according to Brown.

He said the company is discussing the reliability problems with BT North America, and if those issues are not resolved, the firm may choose another international value-added network or install its own private net.

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Voice mail in Hong Kong

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equipment, or to make any modifications to their existing telephone lines. Rather, subscribers use a personal security code to dial in to their own mailbox, enabling them to send, receive, broadcast, save, reply to, redirect or add to messages, which are stored for as many as seven days. The system provides step-by-step instructions.

Because it is a value-added service, voice messaging is not regulated within Hong Kong's existing franchises for voice communications. British Telecom is able to offer the service under the terms of a public nonexclusive telecommunications service license granted to the carrier earlier this year by Hong Kong's postmaster general.

According to Alexander Wong, British Telecom's voice messaging sales manager in Hong Kong, the cost of the service entails a one-time installation charge of $250 Hong Kong and a monthly fee of $250 Hong Kong per mailbox. Usage time is charged at a rate of 25 cents per minute for local messages and at the Hong Kong International Direct Dial rate for international messages.

According to Helen Megan, vice-president of marketing at HANS, AT&T does not offer its voice messaging service anywhere outside the U.S.

Steve Dickinson, information services marketing manager at Hong Kong Telecom, said his company was in the voice messaging market for a number of years but got out several years ago, due to a poor market response. Although Hong Kong Telecom has no firm plans to reintroduce the service, Dickinson said the matter is under review.

PRODUCTS & SERVICES

THE LATEST OFFERINGS FROM VENDORS AND CARRIERS

First Look

Microcom serves up enhanced antivirus pack

Microcom, Inc. recently announced Version 2.0 of its **Virex for the PC** antivirus software, which expands the scope of viruses covered by the software and also provides support for Microsoft Corp. Windows and Novell, Inc. NetWare users.

Virex for the PC 2.0 detects and treats over 500 viruses, more than double the number supported under the original release. Support for Windows and NetWare users means the software can now support users in memory-constrained environments, . the vendor said. A new terminate and stay resident (TSR) module of the software, Virex TSR, requires less than 1K byte of memory.

As a result of the new TSR version, the software recognizes NetWare drives and files for virus scanning and memory-resident monitoring. In addition, it allows net managers to validate programs for use by all users on the network.

Microcom also cut the price of the software from $129.95 to $99.95 and is offering six months of free product upgrades to customers.

Microcom, Inc., 500 River Ridge Drive, Norwood, Mass., 02062; (617) 551-1000.

Computer Logics offers Mac link to Unisys hosts

Computer Logics, Ltd. recently announced **PEPtcp** software, which enables Apple Computer, Inc. Macintosh users to access Unisys Corp. 2200 mainframes by using the Transmission Control Protocol/Internet Protocol to emulate Unisys terminals.

The software, which resides on a Macintosh, supports as many as eight terminal emulation sessions and allows the Macintosh to emulate Unisys U200, UTS 400 and other UTS graphics terminals.

PEPtcp supports the Unisys Personal Emulation Package protocol running over Ethernet or LocalTalk nets supporting TCP/IP. PEPtcp costs $470 and is available now.

Computer Logics, Ltd., 31200 Carter St., Solon, Ohio, 44139; (216) 349-8600.

GUPTA adds LAN version of Quest tool

By Timothy O'Brien
West Coast Bureau Chief

MENLO PARK, Calif. — GUPTA Technologies, Inc. last week introduced Quest for LANs, a multiuser version of its Microsoft Corp. Windows-based query tool that enables local-area network users to access data in many of the leading SQL data base servers.

The server-based Quest for LANs offers the same functions as the single-user Quest product introduced in June: It enables users with no SQL knowledge to access and update SQL tables, create reports and move data into other popular Windows-based applications via the Dynamic Data Exchange.

Quest for LANs works with many popular SQL data bases — such as Microsoft's SQL Server, Oracle Corp.'s Oracle Server, IBM's DB2 and Extended Edition Database Manager — as back-end servers.

"With this package, we are targeting new work groups on LANs that want to get the true benefits of client/server and need access to data without programming," said Umang Gupta, president and chief executive officer of GUPTA.

In order to stimulate interest in the product among first-time data base users, GUPTA has introduced an aggressively priced introductory package that includes a five-user version of Quest for LANs as well as its SQLBase data base server. That package is priced at $995 until Nov. 30. After that date, the price will increase to $1,995. The product is scheduled to be available at the end of September.

Users wanting access to the various data base servers supported by Quest will need to purchase the appropriate host or gateway software separately.

In a related announcement at GUPTA's Developer's Conference, starting today in San Francisco, the company is introducing SQLWindows 3.0, a new version of the graphical development tool that can be used for building client/server SQL data base applications.

SQLWindows now includes more object-oriented functions to make development easier. It also facilitates team development to increase programmer productivity on large applications. SQLWindows 3.0 is priced at $1,295 and should be available in September.

Hand-held scanner tests wiring for 10Base-T nets

PHOENIX — Microtest, Inc. last week announced Next Scanner, a hand-held LAN cabling tester based on an expert system architecture that automatically determines which tests are needed to certify new and existing 10Base-T wiring.

Next Scanner comes programmed with a knowledge base of wiring tests and other data so local-area network administrators can simply key in the cabling type. The unit then identifies which tests must be run, executes them, interprets the data and prints a detailed report.

Similar to the company's other cable testers, Next Scanner can pinpoint a variety of cabling problems. It measures cable length, resistance, noise and distance to faults, in addition to monitoring the percentage of bandwidth used, attenuation and cross talk signal conditions.

"What differentiates Next Scanner is that it was developed using an expert system architecture that interprets the suitability of the cable for a network application based on results of appropriate tests," said Mark Johnson, Microtest's vice-president of test products.

Next Scanner can, for instance, certify if existing wiring is suitable to upgrade from 4M to 16M bit/sec token rings, or determine if a cable can support a particular vendor's LAN adapters.

In addition to printing cable test results, data can be fed to Microtest's Cable Management System (CMS) software residing on a personal computer. The software acts as a data base for test results, enabling users to generate a historical record of test results.

Next Scanner also comes with 256K bytes of flash memory, which enables users to download various test parameters from a personal computer to the device.

Next Scanner costs $3,495, the optional CMS software costs $395, and an optional Tracer 2 hand-held fault locator costs $145. The product is scheduled to ship by the end of the month.

For further information, contact Microtest at 3519 E. Shea Blvd., Phoenix, Ariz. 85028, or call (602) 971-6464.

Brightwork updates LAN control package

Tool inventories LAN's Macs, personal computers and allows monitoring from a central point.

By Salvatore Salamone
Features Writer

TINTON FALLS, N.J. — Brightwork Development, Inc. last week said it has enhanced its LAN Automatic Inventory (LAI) software to audit application usage and monitor Apple Computer, Inc. Macintosh systems as well as personal computers on Novell, Inc. NetWare LANs.

LAI 2.0 enables a net manager from a central point to automatically monitor and pool data on activity relating to hardware devices and applications on a NetWare local-area network, instead of spending a great deal of time physically visiting each workstation to retrieve the data.

LAI 2.0 resides on each file server on the LAN; no software is needed on client nodes. It also probes any Macintosh or personal computer that logs onto a server running the LAI software. Previously, the software did not support Macintoshes. Version 2.0 builds a complete inventory of Macintosh and personal computers connected to the LAN.

Brightwork President Greg Gianforte said the addition of the Macintosh inventory capability makes LAI the only tool capable of monitoring both IBM and Macintosh devices on a NetWare LAN.

The other significant enhancement offered in the LAI upgrade is the ability to detect and audit more than 1,700 applications residing on any personal computer or Macintosh connected to the net. This is accomplished by comparing files residing on a workstation's hard disk to a list of files in a data base on the server.

A software module originating on the server is downloaded to the client workstation, where it scans local hard disk files for a match between a file name on the client's hard disk and the same name stored in a data base on the server. If the names match, other parameters, such as file size, are compared and the information is recorded in a data base on the server.

LAI 2.0's auditing feature detects the version number of an application on a local device. By doing so, the software can minimize network downtime by aiding the net manager when troubleshooting problems.

If several users, for example, have recently upgraded their word processing packages and are experiencing printer problems, the net manager can check which of the users is running the upgraded software. If all have the same version, the net manager can surmise that the upgrade has different printer settings and can then change those settings.

The auditing feature also allows net managers to track the number of copies of each software package on the network. This can help track adherence to site licensing agreements.

The software automatically collects both hardware and software information when a personal computer or Macintosh workstation logs onto the network. The process takes about three seconds to complete.

> Macintosh inventory capability makes LAI the only tool capable of monitoring IBM and Macintosh devices on a NetWare LAN.
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LAI 2.0 stores the information in a current configuration data base, which resides on the server. This information is compared to an equipment data base, and any differences are recorded in a change log data base. This process makes it easier to find any changes in equipment over time.

Also, net managers can print customized reports of equipment from the information stored in the data base files.

LAI 2.0 runs on IBM and compatible computers with 640K bytes of random-access memory running DOS 3.1 or later and requires 10M bytes of local or network hard disk space on each file server. LAI 2.0 runs on LANs supporting NetWare V.2.1 or higher.

The product is scheduled to ship in the fourth quarter and is priced at $695 per file server.

For further information, contact Brightwork Development at 766 Shrewsbury Ave., Jerral Center West, Tinton Falls, N.J. 07724, or call (800) 552-9876.

OPINIONS

VOICE PROCESSING SYSTEMS

BY JAMES BAILIE

It is imperative to pay heed to user need

Network managers and designers must pay greater attention to the issues involved in user acceptance of voice processing. A net manager's credibility can be hurt if the organization implements a voice processing system that causes negative reactions from users. A negative response to a voice processing system is rarely due to technical problems. The greatest cause of a negative reaction is when a technology that was installed with good intentions frustrates the caller whom it is supposed to help.

Causes of frustration vary widely but often are due to:

- Long waiting periods.
- An inability to talk to a "real" person.
- Too many choices to remember.
- Poorly trained receptionists who recycle the caller back into the same voice system that they were trying to exit.
- Impatience with getting to the target party, due to slow methodical prompts.
- Voice prompts that sound too commanding and unpleasant.
- Unreturned messages.

> The friendliness of a system depends more on the implementer and less on the technology.
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Many systems that frustrate end users can usually be redesigned at little additional expense to the user company.

The most common culprit is a mismatch between the system design and the callers' expectation.

Voice response technology should enhance the flow of information. The guiding principles in all application designs should be to:

- Allow easier access to information.
- Improve communications between busy, mobile users.
- Create the shortest path between the source and the destination of information.

Voice processing technology can achieve these goals. With voice processing, information can be distributed 24 hours a day, which can be a blessing for some callers.

Facsimiles can be redirected on a store-and-forward basis, a helpful feature for traveling users. White-collar professionals can resolve detailed issues purely through messaging, eliminating telephone tag and saving time. Customers can make changes to orders directly via push-button entry, giving them greater flexibility.

Working closely with the people that will be operating within the voice processing environment is imperative. Some applications require extensive user training. Other applications require training only for receptionists. Many applications require changes to the call-forwarding hierarchy.

Voice processing systems, like computers themselves, are here to stay. Do not underestimate potential negative user reaction.

The friendliness of a system depends more on the implementer and less on the technology. The voice processing system that goes on-line on day one may not cause frustration until day 200. Sometimes the result of changes in office location and rotation of staff can be a loss of focus on the need for user friendliness.

Success in this field depends greatly on user acceptance, so network designers should plan for it throughout the project's life cycle.

Bailie is an independent consultant based in Bethesda, Md., who specializes in voice processing applications. He can be reached at (301) 564-5965.

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EDITORIAL

Government deserves praise as GOSIP enters second year

A year ago this month, the Government Open Systems Interconnection Profile (GOSIP) received a tremendous boost when compliance with the specification was made mandatory for all federal agencies.

The U.S. government deserves plenty of praise for its support of GOSIP. But, as expected, the policy so far has had little visible impact on the user community in general.

During this past year, several major government contracts have demanded compliance with GOSIP, as the regulations have required, but there have been few significant GOSIP network implementations. In addition, the contracts that have been announced refer to such plain-vanilla open systems functions as X.400 messaging and such transport functions as X.25.

Of course, GOSIP isn't at fault here. There simply aren't many OSI products that do much more than transport data. In time, the necessity of complying with GOSIP will encourage vendors to make higher level products. Unfortunately, powerful high-level capabilities, such as remote procedure calls, may take years to emerge as OSI standards.

Admittedly, there have been minor problems caused by the GOSIP requirement. Some government users, for example, have found they can't dial in to their new X.400 electronic mail systems, which are required under GOSIP. The absence of a dial-in capability has been frustrating for some government users, but it was expected. Standard products generally lag behind proprietary products in terms of functionality.

We believe, despite such minor inconveniences, that supporting GOSIP is important. The GOSIP movement is now quite active, and hundreds of people are involved in developing the specification. GOSIP is being upgraded regularly. Version 2.0, which includes such new functionality as the Virtual Terminal Protocol and limited support for the Office Document Architecture, was published in April.

What's more, the GOSIP process has already defined specific conformance tests for products. Laboratories equipped to conduct the tests have been granted the GOSIP seal of approval, and the first few GOSIP-compliant products have been certified.

Government users can, if their waiver requests are approved, avoid the GOSIP requirement and purchase proprietary products. We urge that waiver approvals be kept to a minimum. Strict enforcement of the GOSIP mandate will keep vendors focused on providing GOSIP products, which will serve users everywhere.

OPINIONS

NETWORK RETURN ON INVESTMENT

BY NATHAN MULLER

The emerging strategic role of network managers

With corporate executives becoming increasingly focused on short-term profits, it is falling on middle management to bring up and advance causes that are strategic in nature. Among those best qualified to handle this chore are managers of communications networks. Increasingly, they are coming to understand technology's role in supporting key business operations and sustaining competitive advantage.

Despite their short-term focus, executives still control corporate purse strings. This means managers will have to present a sound business case to secure their share of limited corporate resources.

With many projects, it is often difficult to do a classic return-on-investment (ROI) analysis, particularly in a depressed economy. Even in the best of times, quantifying the benefits of technologies such as Integrated Services Digital Networks and electronic data interchange is not easy to do because much of the information needed to perform an accurate cost-benefit analysis is not readily available.

With EDI, for example, current accounting methods usually do not isolate the costs of producing a paper purchase order. Thus, projections of EDI's expected savings are not only difficult to do, but the well-intentioned exercise may expose the network manager to criticism from department heads who are competing for scarce resources for their own projects.

Although senior executives are generally resistant to long-term projects that cannot be justified on the basis of ROI, they will not lightly dismiss a compelling proposal that is based on strategic benefits. Therefore, the onus is on information systems and network managers to talk in these terms, stressing issues such as improved corporate image and productivity, increased customer satisfaction and loyalty, market positioning, and expanded business opportunities.

Muller is manager of consultant relations at General DataComm, Inc. in Middlebury, Conn.

To deploy or not to deploy

In attempting to determine how a technology will affect the company, network managers must address the following strategic questions:

- Will deployment of the technology allow the company to enter a new market?
- Will deployment lower a barrier and allow the company to compete more effectively?
- Will deployment permit the company to offer new services or expedite the delivery of existing services?
- Will deployment enable the company to generate new revenues or at least produce significant cost savings?
- Will deployment either prematurely obsolete current products before they have been fully depreciated or impact long-term service agreements? Or will immediate deployment result in savings that override such concerns?
- Will implementation of the technology by competitors have an adverse impact on the company? If so, how long an interval may safely elapse before the company starts experiencing negative results? How will these negative results manifest themselves? What are the possible ways competitors will exploit such a newfound advantage, and within what time frame?

> Despite their short-term focus, executives still control corporate purse strings.
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When pitching the strategic benefits to top management, three metrics may be used: customer support, productivity improvement, and direct and indirect savings.

The customer support metric can show how the technology would give customers faster access to corporate services. The productivity metric can show how it would improve staff productivity by eliminating redundant tasks.

The savings metric can be used to justify the technology in terms of the more efficient utilization of computer and communications systems, which can prolong the useful life of current capital investments and save money in the short run.

When stating the business case for ISDN, for example, do not overlook the competitive business environment. Project approval tends to fare better if you can show that competitors are already using the technology with apparent success or that an advantage can be gained over a competitor that seems to be ignoring the technology.

Of course, cost savings are always factored into the equation somewhere along the line. With ISDN, it's a good idea to mention that a coast-to-coast videoconference costs only $75 an hour. The savings compared to airfare, hotel rooms and meals is nothing less than astounding. And using ISDN for EDI eliminates the need for, and cost of, dedicated lines that may go unused most of the time. With ISDN, many such synergies are worth exploring.

The sooner network managers can relate to corporate executives the many ways in which information can be efficiently and economically exchanged with customers and suppliers, the larger the ROI will be. The successful deployment of technology can directly increase corporate sales and improve cash management — which even the most shortsighted executive can appreciate.

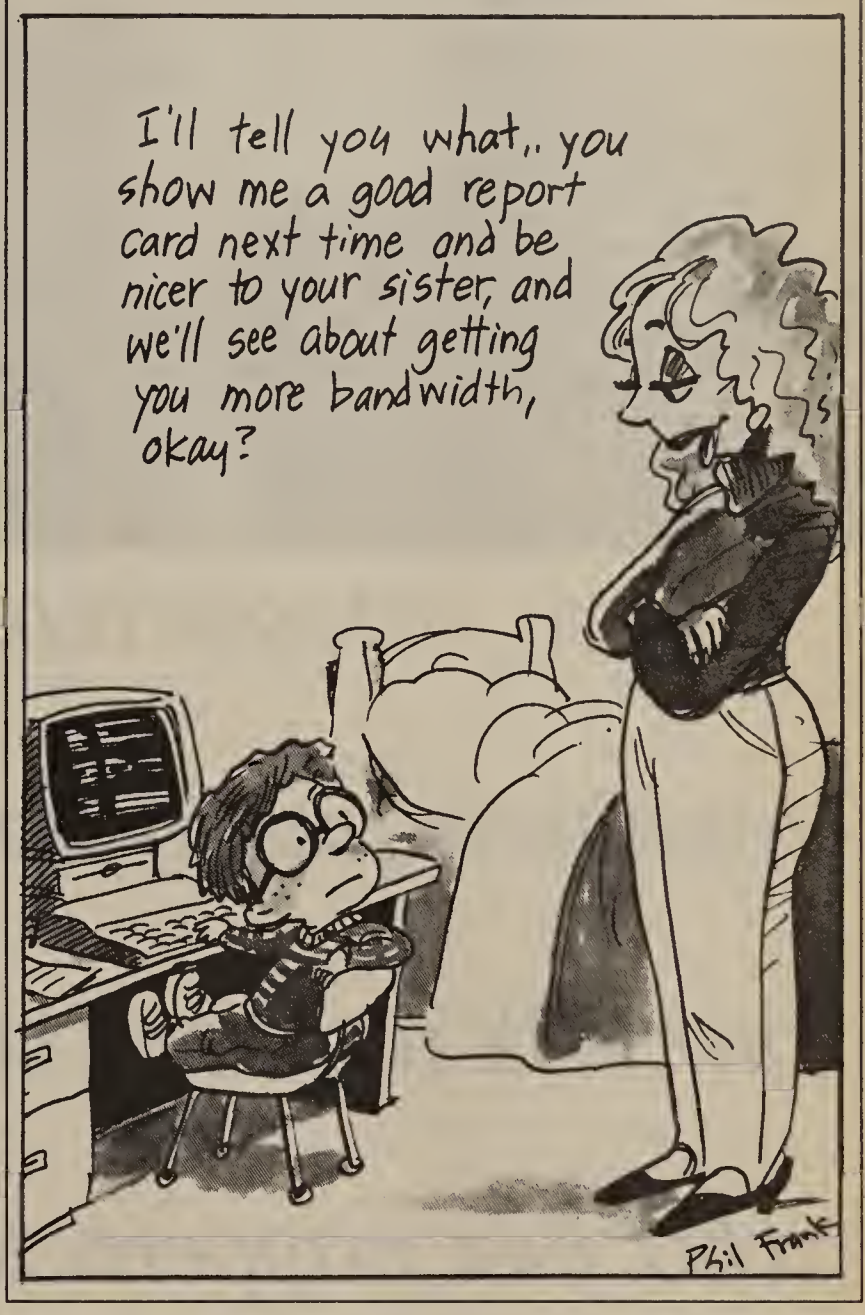
DO YOU, LIKE LILLIAN HELLMAN, refuse to "cut your conscience to fit this year's fashions?" If so, let the network community know about it. Write a column for *Network World.*

Columns should be 600 words in length and submitted on disk, via modem or through MCI Mail at 390-4868.

If you'd like to write a column, call Alison Conliffe, associate features editor, at (508) 820-7416 or fax your idea to us at (508) 820-3467.

TELETOONS

BY FRANK AND TROISE



LETTERS

Fixed-length of IPX

I would like to correct a mistake in Kris Herbst's feature article "High-speed era dawning for packet-switched nets" (*NW,* July 29).

The article states that the StrataCom, Inc. fast packet IPX switch transmits variable-length packets between nodes. In fact, the IPX is a cell relay switch; it transmits fixed-length cells between IPXs, regardless of the size of the packets sent to it by other equipment.

This point is central to an understanding of the difference between frame relay and cell relay. Frame relay is an interface technology, which means it is the language spoken between the access equipment, such as a router or X.25 packet assembler/disassembler, and the switching equipment, such as the IPX. Because the variable-length packets that frame relay uses cannot guarantee the fixed delay needed by applications such as voice and video, frame relay is intended for data only.

Cell relay (also called fast packet; the terms are synonymous) is a networking technology spoken between wide-area switches. Cell relay, which uses fixed-length packets known as cells, is a suitable method for transmitting not only data, but all forms of traffic, including voice and video.

All traffic — voice, video, image, low-speed data and frame relay data — can be statistically multiplexed over the wide-area network in fixed-length cells. This offers the advantages of bandwidth sharing and the fixed delay needed by voice and video.

Frame relay traffic is transmitted through the network faster because it has access to

(continued on page 42)

Network World *welcomes letters from its readers.*

Letters should be typed and double-spaced. Mail them to Editor, Network World, *161 Worcester Road, Framingham, Mass. 01701.*

Letters may be edited for space and clarity.

Doubt has an office. Anxiety has a key to the

Ambition and a lunch date with Paranoia. And me

our PBX works as consistently as the tides. And just as

who just happens to be passing by my office at this

That ring is a chorus of thousands of AT&T workers

was a peerless decision...." And as the phone rings

residual value in the industry. It's ready to grow like

maintenance program unequaled...." But Blame

looking for some other doorway to darken. Just as

asking me if I had lunch plans.

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washroom. Insecurity has a stack of messages from I'm staring at my telephone celebrating the fact that I'm doing this my phone rings, and I say to Blame, time, I say, "Blame, you know what that ring is? reminding me that buying their DEFINITY® *System again I say, "Blame, this system has the highest flowers in springtime and is supported by a didn't hear this last part, as he was down the hall well though, it was Advancement on the phone*

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DATACOM

BUYER'S GUIDE

DSU/CSUs

Digital connectivity

Once considered esoteric devices, combined data service unit/channel service units (DSU/CSU) now play a prominent role in user networks. In fact, these devices, which allow users to link up with carriers' switched and leased digital services, are becoming a commodity item.

Until the mid-1980s, combined DSU/CSUs did not even exist. There was one major vendor of DSUs and CSUs for end users — AT&T. Relatively few digital services were available from carriers; AT&T's Dataphone Digital Service was the most well-known.

Other carriers offered digital services, and other vendors, such as General DataComm, Inc., developed and sold DSUs and CSUs. But it wasn't until after the divestiture of AT&T in 1984 that DSUs and CSUs were regularly combined into a single unit for end users.

Now, with many more digital services and carriers to choose from, users can buy a combined DSU/CSU or separate DSU and CSU from nearly 40 vendors that compete largely on price and features (see accompanying charts). Another 20 or so vendors resell the units these vendors make.

Some of the early DSU/CSU pioneers, such as General DataComm and AT&T (now AT&T Paradyne), are still major forces in the market. Verilink Corp. carved out a large niche for itself in the late 1980s; and major modem makers such as UDS and Codex Corp. (both now subsidiaries of Motorola, Inc.) joined the fray as well.

DSU/CSUs have become all the more ubiquitous today due mostly to the ever-growing user appetite for high-quality, digital services. To satisfy this demand, carriers are offering more digital services than ever before, including switched and dedicated services, and at lower and lower prices. So, as user demand grows,

(continued on page 33)

CHART • GUIDE

Buyer's Guide charts comparing CSUs, DSUs, 56K/64K DSU/CSUs and T-carrier DSUs begin on pages 32, 33, 36 and 39, respectively.

Once exotic, now practically ubiquitous, DSU/CSUs are seizing the transmission equipment market.

Briere is president and Guptill is an associate of TeleChoice, Inc., a Montclair, N.J., telecommunications consultancy specializing in long-distance service analysis and network design. They can be reached at (201) 746-0200.

By DANIEL BRIERE and BRUCE GUPTILL

NETWORK WORLD

Channel service units

Vendor	Product; type (stand-alone or rackmount-able)	Configura-tions supported (1)	Data rates supported; top operating range	Services supported (dedi-cated; switched)	Clocking (Internal, external); source (if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (2)	User-programmable features (standard; optional)	Network management/ diagnostics (standard; optional)	Telephone technical support; number	Price; warranty
ADC Kentrox Portland, Ore. (800) 733-5511	T-SERV and T-SMART; both	Point-to-point, multipoint; LDM	1.544M bit/sec; 4,000 ft at 1.544M bit/sec over 24 AWG	T-1; none	Internal, external; line	4-wire; 4-wire	4-wire: full duplex, half duplex, simplex	Synchro-nous	Diagnostic: code detected, loss of signal, local and network loops active, alarm indication signal detected, bipolar violation, sending code/far end loop-backs, power on; additional features (available on T-SMART only): receiving data, excessive errors, out of frame, yellow alarm, low pulse density	Standard (T-SERV): Line or test loop-backs, pulse stuffing, QRSS (per AT&T 62411), pulse density enforcement disable, keep alive, framed or unframed, line buildout at 0, 2.5, 15 and 22.5 dB; additional features (available on T-SMART only): B8ZS, ESF (AT&T Publication 54016), pulse density, T1.403 compatibility	Standard (T-SERV): Local loop-backs, network loop-back code generator; additional features (available on T-SMART only): generates loop-back codes, test codes, monitors far end via facility data link, alarm dial-out via modem, current status displays, 24-hr history, alarms, error events, network management software for IBM and compatible microcomputers	Yes; (800) 733-5511	T-SERV: $1,200, T-SMART: $2,550; 2 years
Digital Link Corp. Sunnyvale, Calif. (408) 745-6200	DL551A, DL551X T-1 CSU product family; both	Point-to-point	1.544M bit/sec; 655 ft at 1.544M bit/sec over 22 AWG	T-1; T-1	Internal, external; DTE	T-1; T-1, 4-wire	T-1	Synchro-nous	Diagnostic: power, loop-backs, frame error, frame loss, bipolar violations, ESF performance data, network and DTE status and alarms; configuration (DL551X series only): clock selection, data rate, clear channel mode, line code, framing	Standard: local or line power, line buildout, alarm thresholds, line coding, framing format, clear channel mode, data rate; optional (DL551X series only): remote dialout, additional test patterns, external alarm interface	Standard: DTE loop-backs, network loop-backs, terminal interface, Digital Link Network Management System interface (DL551X series only); optional (DL551X series only): remote dialout, external alarm interface	Yes; (408) 745-6200	$1,295 to $2,495; 2 years
Dowty Communications (formerly CASE/Datatel, Inc.) Cherry Hill, N.J. (800) 227-3134	DCP3552, DCP3555; stand-alone	Point-to-point; LDM	DCP3552: Nx56K and Nx64K bit/sec; DCP3555: 1.344M bit/sec, 1.536M bit/sec; both: 1.544M bit/sec; 6,000 ft at 1.5M bit/sec over 19 AWG	T-1, fractional T-1; none	Internal, external; network	V.35, RS-422, T-1; 4-wire	DCP3555: 4-wire: full duplex, half duplex, simplex; both: T-1	Serial binary, syn-chronous	Diagnostic: loop-backs, test pattern; configuration: all available configuration data	None	Standard: all configuration and diagnostic functions	Yes; number published to customers	DCP3552: $2,475, DCP3555: $3,175; 1 year
General DataComm, Inc. Middlebury, Conn. (203) 574-1118	DataComm 551, 551/AS1; both	Point-to-point; LDM	1.544M bit/sec; 6,300 ft at 1.544M bit/sec over 22 AWG	T-1; none	Internal, external; DTE or network	4-wire DSX; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: power, bipolar violations, ones, zeros, loop-backs, send data, receive data; additional features (on 551 only): test, alarm Indications, low average density, equipment no signal, hourly and 24-hr reports, scheduled performance reports; configuration: various addressable channel and CSU configuration parameters	Standard: 551/AS1: line buildout selection, keep-alive type, span power selection; 551: supervisory port, D4 superframe or enhanced superframe format, AT&T and ANSI ESF formats, AMI and B8ZS coding; optional (551 only): EIA 530 interface, cascade port, data rate adaptor for operation down to 2.4K bit/sec	Standard: front panel network jacks, supervisory port (551 only); optional: performance monitor card (allows monitoring of networked 551s)	Yes; number published to customers	551/AS1: $1,495, 551: $2,195; 1 year
Racal Data Communications Sunrise, Fla. (800) 722-2555	Intelligent Channel Service Unit Series; both	Point-to-point, multipoint	1.544M bit/sec; 5,000 ft at 1.544M bit/sec over 22 AWG	T-1, fractional T-1 (trans-parently); none	External; channel bank, PBX, multiplexer	RS-232; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: local and remote loop-backs, test jacks, LED indicators for line, DTE, loop status	Standard: line coding, framing alarm thresholds, test signals, test reports, circuit name	Standard: alarm dialout, dial-in, major/minor alarms	Yes; (800) 824-4045	$2,410 for basic unit; 1 year
UDS Motorola Huntsville, Ala. (205) 430-8000	T1-CSU, both	Point-to-point; LDM	1.544M bit/sec, 3,000 ft at 1.544M bit/sec over 22 AWG	T-1; none	External; network	DSX-1; 4-wire	4-wire: simplex	Serial AMI or B8ZS	Diagnostic: unit in test, network signal present, DTE present, alarm, network bipolar violation, low ones density	Standard: power selection, test code options, grounding, keep-alive signal, network line buildout, D4 framing, DTE line equalizer, pulse stuffing options	Standard: DTE loop-backs, test loop-backs, local loop-backs, loop-backs with test pattern, network loop-backs	Yes, (205) 430-8000	$1,295, 1 year
Verilink Corp. San Jose, Calif. (408) 945-1199	4016R Multiline CSU, 4019 CSU; both	Point-to-point; LDM	1.544M bit/sec; 655 ft at 1.544M bit/sec	T-1, fractional T-1; T-1 (4019 only)	External; network loop	4-wire; 4-wire	4-wire: full duplex	NA	Diagnostic: network and DTE status; configuration: network and DTE test configuration	Standard: extended DTE range, full configuration control (4016R only)	Standard (4016R only): front panel ASCII display, Verilink VeriNet 2 software	Yes; (800) 543-1008	4019: $1,250, 4016R: $2,150, 10-line rack: $500; 2 years
	551VST L2; rackmount-able	Point-to-point; LDM	1.544M bit/sec; 655 ft at 1.544M bit/sec	T-1, fractional T-1; T-1	External; network loop	DB15 or WireWrap; 4-wire	4-wire: full duplex	NA	Diagnostic: network and DTE status; configuration: network and DTE test configuration	Standard: full configuration control, extended DTE range	Standard: Verilink VeriNet 2 software	Yes; (800) 543-1008	$3,250; 2 years

AMI = Alternate mark inversion
AWG = American Wire Gauge
B8ZS = Binary 8-zero suppression
CEPT = Conference on European Posts & Telecommunications
CSU = Channel service unit
DTE = Data terminal equipment
EIA = Electronic Industries Association
ESF = Extended superframe format
LDM = Limited-distance modem
LED = Light-emitting diode
NA = Not applicable
QRSS = Quasi-random signal source

FOOTNOTES:
(1) Includes unit's ability to act as a limited-distance modem, if applicable.
(2) All units feature either LED or LCD displays. Some offer both; others offer external display jacks.

This chart includes a representative selection of CSUs. These vendors may offer other CSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

NETWORK WORLD

Data service units

Vendor	Product; type (stand-alone or rackmount-able)	Configura-tions supported (1)	Data rates supported; top operating range	Services supported (dedi-cated; switched)	Clocking (internal, external); source (if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (2)	User-programmable features (standard; optional)	Network management/ diagnostics (standard; optional)	Telephone technical support; number	Price; warranty
AT&T Paradyne Largo, Fla. (800) 482-3333 ext. 507	3500 Series DSU; both	Point-to-point, multipoint, multidrop; LDM	2.4K to 64K bit/sec; 28,500 ft at 64K bit/sec over 22 AWG	56K bit/sec DDS, 64K bit/sec; none	Internal, external; from DDS facility or DTE	RS-232, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Synchro-nous	Diagnostic: DTE interface signals, facility signal indication, DSU/facility alarm	Standard: DTE interface selection, power level, speed, clocking	Standard: integral test pattern generator/checker, loop-backs	Yes; number published to customers	$750; 1 year
Digital Link Corp. Sunnyvale, Calif. (408) 745-6200	DL2048V CEPT Converter; both	Point-to-point; LDM	2.048M bit/sec; 4,000 ft at 2.048M bit/sec over RG58 coaxial	CEPT E-1; CEPT E-1	Internal, external; CEPT network	V.35, RS-449; CEPT E-1	CEPT E-1	Synchro-nous	Diagnostic: DTE status, cyclic redundancy check-4 errors, framing errors, high-density bipolar 3-zero violations; configuration: loop-back state	None	Standard: DTE loop-backs, network loop-backs, jacks for external test equipment	Yes; (408) 745-6200	$2,220; 2 years

AWG = American Wire Gauge
CEPT = Conference on European Posts & Telecommunications
DDS = Digital data service
DSU = Data service unit
DTE = Data terminal equipment
LDM = Limited-distance modem

FOOTNOTES:
(1) Includes unit's ability to act as a limited-distance modem, if applicable.
(2) All units feature either LED or LCD displays. Some offer both; others offer external display jacks.

This chart includes a representative selection of DSUs. These vendors may offer other DSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

(continued from page 31)

carrier services increase and rates drop, further increasing user appetite for digital connectivity. As usage of these services grows, so does the demand for DSU/CSUs.

CSUs connect a digital phone line from the carrier (usually T-1 or lower speed) to a multiplexer, channel bank or any other customer premises equipment that produces a digital signal output. CSUs terminate the carrier transmission line and perform signal retransmission before the data enters the user network.

CSUs also perform a variety of other functions, including line conditioning and equalization, loopback testing from the telephone companies' central office and digital signal regeneration. They also monitor for bipolar variations and ones-density violations as well as perform diagnostics (see graphic, this page).

DSUs sit between the CSU and the user's data terminal equipment (DTE). They provide the interface from the carrier network to the customer premises.

DSUs allow users' DTE to connect to the carrier network. DSUs provide the standard interface to the DTE that sends information and perform functions not typically performed by CSUs, such as signal translation, data regeneration, control signaling, signal sampling, reformatting and timing.

DSUs ensure that signals going to or from the network conform to carrier guidelines for ones density and bipolar formatting. When on the receiving end, DSUs also extract timing information from the received data signal.

Digital advances

DSU/CSUs work with both leased and switched circuits. But there has been more interest today in transmitting data over high-speed switched circuits.

In fact, visit the floor at any telecommunications trade show and you'll hear about the growth of available switched digital services. Tariffs for switched digital services are also falling as more switched digital services become available. And, of course, as prices fall, the number of users increases and so does the need for DSU/CSUs.

Several vendors offer products that work with switched digital services, which can be supported on 2-wire circuits. These are listed under the services supported heading in the accompanying charts.

But traditionally, carrier digital services have been provided over a leased, 4-wire access circuit. Four-wire technology was the staple of AT&T Dataphone Digital Service provision and has remained the most common cabling used. Central office and customer premises equipment are typically manufactured for 4-wire transmission, which provides good transmission range and inherent signal quality. Today's leased lines are still mostly 4-wire circuits.

The rise of 2-wire

This is changing, however, as new technologies appear that allow digital transmission over 2-wire cabling. Switched digital services, of course, travel over 2-wire circuits.

One innovator in 2-wire plant technology and the growth of switched data services in the local loop is Northern Telecom, Inc., which developed its Data Path 2-wire transmission technology in the 1980s and began building and selling central office equipment to support it during the last few years. This equipment is capable of sending digital transmissions over 2-wire copper plant as far as 3.5 miles without repeaters.

Several regional Bell holding companies and other carriers are considering implementing Data Path and other 2-wire technologies.

The other significant technology trend in this market is the combination of DSU/CSUs with other customer premises equipment, most notably multiplexers. This is not a totally new development, as vendors have been building at least some DSU functionality into multiplexers for some time. What is new is the complete subsuming of DSU/CSU functionality, including all the interface, management and diagnostic features into a multiplexer. And users are starting to take notice.

Most of the vendors listed in the comparison charts are also multiplexer vendors and, as such, are either investigating incorporating DSU/CSUs into their multiplexers or have already done so. Larse Corp., for example, incorporates a DSU/CSU into its Split-T fractional T-1 multiplexer. The Split-T handles data rates from 56K bit/sec up through T-1 over leased lines. Like most other DSU/CSUs, it offers a range of management and diagnostic features, many of which are user-programmable.

Another vendor following the same strategy is Digital Link Corp. of Sunnyvale, Calif., which offers two combined DSU/CSU multiplexers, the DL100 and DL3000.

UDS Motorola has just unveiled a combined DSU/CSU high-speed modem, the DDS/V.32 — a multirate DSU/CSU for dedicated circuits of up to 56K bit/sec with dial backup using a plug-in, UDS Motorola-developed V.32 modem.

Future plug-in modules will allow users to back up their 56K bit/sec leased lines with dial-up, switched 56K bit/sec service. A V.32bis module is also planned.

There are advantages to building DSU/CSU functions into a multiplexer or other customer premises equipment or building a modem into a DSU/CSU. The most significant is the centralized location of all necessary digital

(continued on page 34)

Several vendors offer products that work with switched digital services.

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Several RBHCs and other carriers are considering implementing Data Path.

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There are advantages to building DSU/CSU functions into a multiplexer.

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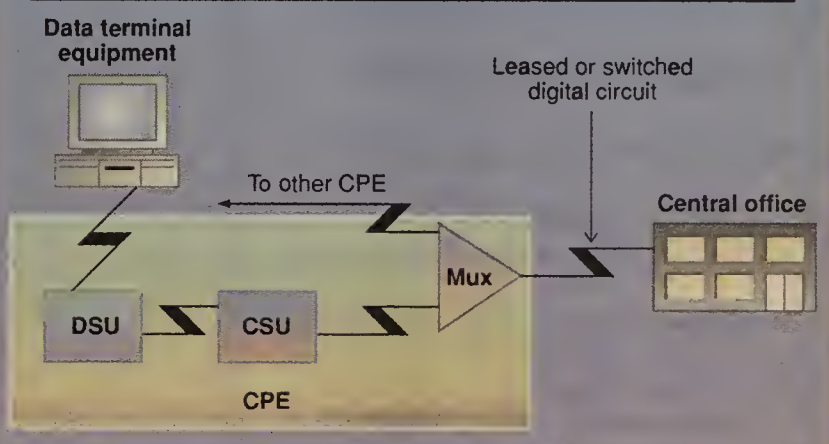
DSU/CSU placement within the network



The DSU and CSU can be separate devices, as shown here, or combined in one unit.

CPE = Customer premises equipment DSU = Data service unit
CSU = Channel service unit

GRAPHIC BY SUSAN SLATER SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

(continued from page 33)
customer premises equipment and DTE interfaces.

"Putting everything in one box greatly simplifies the life of the network manager," says Steve Mills, director of product development for UDS Motorola.

With enough features, a combined DSU/CSU multiplexer would be a good piece of equipment, according to Benny Maynard, systems engineer for BI-LO Foods, a 180-store supermarket chain in Georgia and the Carolinas.

"If nothing else, it'll save some space in the computer room," he says. BI-LO has about 300 UDS Motorola DDS/MR1 DSU/CSUs installed in its network.

Regardless of advances in combining the technologies, DSU/CSUs will not go away, as Michael Becker, senior market analyst for Astrocom Corp., points out. "At best, CPE vendors will purchase a DSU/CSU card set and put it under the skin [of the CPE]," he says. "The actual interface requirements may change depending upon how quickly customers adopt new technology, but the requirements for the functions still remain."

A caveat for users may be a potential lack of network flexibility; the more functions built into a device, the less flexible that device often becomes.

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A caveat for users may be a potential lack of network flexibility; the more functions built into a device, the less flexible that device often becomes, especially when added to a network with other vendors' equipment.

Potential problems

Incompatibility is a problem users often encounter when setting up networks of equipment from multiple vendors. One vendor's multiplexers won't talk to another's; high-speed modems from different vendors rarely interact except at the lowest levels of connectivity.

However, incompatibilities between vendor DSU/CSUs are usually a problem only when each vendor implements different options for accomplishing the same function, such as management or diagnostic reporting, or when a device has multiple built-in functions that narrow its ability to communicate with devices from other vendors.

The reason for this is that, in their ongoing efforts to differentiate their products, vendors are forever adding features based on proprietary technologies. If one vendor has added any proprietary technology for features outside of accepted standards, those features may not be usable when operated with another vendor's product.

For example, if a vendor uses a proprietary rate adaption scheme that enables the unit to adapt to the transmission rate being used, then a DSU/CSU from the same vendor, supporting the same rate adaption scheme, would be necessary at the other end of the circuit.

There are some things users can do to make sure a particular unit is indeed reliable, says BI-LO's Maynard.

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When you talk to users and vendors about the most important concern when shopping for DSU/CSUs, the top answer will come back almost unanimously: reliability.

"Usually, you're going to be dispatching these boxes to remote offices, and you don't want to have to send out a technician to repair [them]," says Scott Augerson, senior director of digital marketing for Motorola Codex, based in Mansfield, Mass. "It's got to be reliable."

Taking the user's word

There are some things users can do to make sure a particular unit is indeed reliable, says BI-LO's Maynard, but he doesn't suggest simply asking the vendor.

"We never take the vendor's word for anything," Maynard says. He suggests users query other users for information on DSU/CSUs or, in fact, anything they're planning to purchase. "Try to find users with similar applications," he adds.

BI-LO canvassed other users and also set up its own in-house test networks using multidrop lines with three drops each.

A paper path like this can send reliability around the bend.

Announcing a design so reliable, it'll have the competition running in circles: the virtually straight paper path of the new IBM Personal Printer Series II dot matrix printers.

Starting with a simpler, no-U-turn paper path, they're engineered from the inside out for smooth, worry-free paper handling.

Four-part forms glide through PPS II 24-pin models easily. Even six-part forms can't faze the 9-pin models. Labels and thick paper stocks feed straight and true, too.

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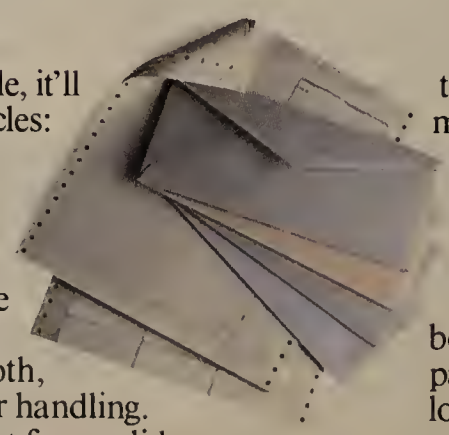

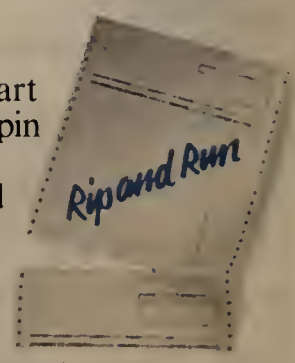

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THE STRAIGHT-PAPER-PATH,

BI-LO's technical staff ran their network applications over the test network, doing all they could to mess things up, and proved the reliability of the UDS DDS/MR1 DSU/CSUs to their satisfaction.

BI-LO's test makes an important point: It tested the proposed DSU/CSUs in their environment, using their own real-life business applications. It used information from vendors and other users only as a baseline to help its managers determine their choices. BI-LO's main guide in making the choice was the application with which the DSU/CSUs would be involved.

And that synthesized the next most frequent answer you'll get from users: Buy a device with the features to fit your applications.

If your network uses 56K bit/sec leased lines from point to point and you have no plans to change that in the next few years, get a device that handles 56K bit/sec leased lines; don't buy something that also handles T-1 circuits.

If you're planning to use 2-wire switched data services, but have an established leased-line network already, buy the devices that support both.

But don't buy shortsightedly. If your firm has thoughts about upgrading its network — and most considering purchase of customer premises equipment do, or they wouldn't be considering the purchase — buy for today and tomorrow.

> If your firm has thoughts about upgrading its network, buy for today and tomorrow.
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The newer DSU/CSUs available now have more features, such as support for fractional T-1, more management capabilities and are able to support more rates than before.

As the market continues to mature, vendors will offer them at decreasing prices.

After the sale

A third key criterion for DSU/CSU purchase is service and support. Once you set up that network, you want to be sure the vendor will be available in case anything goes wrong.

The first place to turn is your telephone. As shown in the charts, all the vendors in our survey provide technical support via telephone (some provide toll-free technical support).

Check the warranty information, as well. See what's covered and for how long. Basic warranty period information is included in the accompanying charts.

The fourth factor for purchase evaluation is network management and diagnostic capabilities.

> BI-LO's Maynard and others agree that, if there's a problem, the carrier will test the circuit down to the DSU/CSU anyway.
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Vendors, eager to differentiate themselves, are building more management interfaces and reporting capability into their devices, from DSU/CSUs to modems to public branch exchanges to multiplexers.

So it shouldn't be surprising that they would consider network management capabilities to be high on the user shopping list.

Users like network management features, but one automobile manufacturer's former net manager who requested anonymity says it is not that big a deal.

Other network managers assert it is the carrier's responsibility to provide troubleshooting and diagnostic capability.

BI-LO's Maynard and others agree that, if there's a problem, the carrier will test the circuit down to the DSU/CSU anyway. "The telco is your best source of diagnostics," Maynard says. "You're paying for it anyway, so let them do it."

Support for ESF

If network management is an important check list item, you may want to note in the accompanying charts each vendor's support for extended superframe format (ESF), which is key to the increasing network management capabilities that carriers are now providing to users. ESF frames are designed to allow the extra information needed to constantly check on circuits.

(continued on page 42)

Introducing the straight, simple paper path of the new IBM PPS II printers.

For about the same price as the competition, PPS II 9-pin models deliver 320 CPS in FastDraft, 65 CPS in NLQ and four built-in fonts. 24-pin models boast 200 CPS FastDraft, 60 CPS LQ and eight fonts. And every PPS II has a two-year limited warranty.

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NETWORK WORLD

56K/64K DSU/CSUs

Vendor	Product; type (stand-alone or rack-mountable) (1)	Configurations supported (2)	Data rates supported; top operating range	Services supported (dedicated; switched)	Clocking; source (internal, external; if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (3)	User-programmable features (standard; optional)	Network Management/ diagnostics available (standard; optimal)	Telephone technical support; number	Price; warranty
ADC Kentrox Portland, Ore. (800) 733-5311	DSU/CSU Models 100 and 200; both	Point-to-point, multipoint	56K, 64K bit/sec; 14,100 ft at 56K bit/sec over 26 AWG	None dedicated; 56K and 64K bit/sec switched	External; network	V.35; 2-wire	2-wire: full duplex	Synchronous	Model 200: Diagnostic: local maintenance, tests, loop-backs, remote maintenance and loop-backs, BERT; configuration: parts, system, registers, defaults	Model 200: diagnostics and tests	None	Yes; (800) 733-5511	Model 100: $1,350, Model 200: $1,895; 2 years
	DSU/CSU Model 300; both	Point-to-point, multipoint, multidrop; LDM	2.4K to 72K bit/sec; 16,896 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS, fractional T-1; 56K bit/sec	Internal, external; DTE	RS-232, V.35; DDS Type I and II	DDS: full duplex	Synchronous, asynchronous	Diagnostic: BERT information, loop-back tests, self tests, pattern tests; configuration: DSU, port, network dial protocol, network management	Standard: limited distance modem operation; optional: modem sharing unit, dial restoral, KENTROX Network Manager	Standard: line statistics, alarm status, port status, bit error rate tests, loop-back tests, pattern tests; optional: KENTROX Network Manager (supports IBM NetView)	Yes; (800) 733-5511	$795; 2 years
Astrocom Corp. St. Paul, Minn. (612) 227-8651	2300 DSU/CSU; both	Point-to-point, multipoint; LDM	2.4K to 56K bit/sec; 6.8 miles at 72K bit/sec (as LDM)	56K bit/sec DDS; none	Internal, external; network	RS-232, V.35; 4-wire	DDS: full duplex; 4-wire: full duplex	Synchronous	Diagnostic: none; configuration: all network configuration parameters	None	Optional: IBM LPDA NetView Interface	Yes; (612) 227-8651	$735; 2 years
AT&T Paradyne Largo, Fla. (800) 482-3333, Ext. 507	Comsphere 3600 DSU/CSU; both	Point-to-point, multipoint, multidrop; LDM	2.4K to 64K bit/sec, plus others with optional integral multiplexer; 28,500 ft at 64K bit/sec (as LDM)	56K bit/sec DDS, 64K bit/sec; none	Internal, external; from DDS facility and from DTE	RS-232, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Synchronous, asynchronous (with optional multiplexer)	Diagnostic: DTE interface signals, DSU status, facility status, test indications; configuration: line speed, clocking; with optional multiplexer: TDM port speeds, backup speeds	Standard: DTE interface, transmit power level, speed, clocking, streaming terminal timer; optional (with optional TDM): port display, dial restoral timers and security levels, user password	Standard: in-band using standard DOS facilities, integral test pattern generator/-checker; optional: in-band compatible with IBM LPDA-2	Yes; number published to customers	$1,550; 1 year on-site
Datalink Ready, Inc. Melbourne, Fla. (407) 676-0500	NMS 510; both	Point-to-point, multipoint; LDM	2.4K to 64K bit/sec; 6,000 ft at 56K bit/sec over 22 AWG (as LDM)	56K bit/sec DDS, 64K bit/sec; none	Internal, external; network or other master source	RS-232, V.35, optional EIA-530; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex	Synchronous, asynchronous	Diagnostic: line loop-backs, remote loop-backs, self-tests; configuration: soft strapping, status and monitoring	None	Optional: end-to-end error rate, monitor line characteristics, control and calibration	Yes; (407) 676-0500	$1,725 (rack-mountable), $1,795 (stand-alone); 1 year
Dowty Communications, Inc. (Formerly CASE/Datatel, Inc.) Cherry Hill, N.J. (800) 227-3134	DCP4256; both	Point-to-point, multipoint, multidrop; LDM	2.4K to 56K bit/sec; 10 miles at 56K bit/sec over 19 AWG	56K bit/sec DDS; none	Internal, external; from external clock pin	RS-232, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Serial binary, synchronous, asynchronous	None	None	None	Yes; number published to customers	$735; 1 year
	DCP3081; both	Point-to-point, multipoint, multidrop; LDM	2.4K to 56K bit/sec; 3 miles at 56K bit/sec over 19 AWG	56K bit/sec DDS; none	Internal, external; from external clock pin	RS-232, RS-422, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Serial binary, synchronous	None	Timing, control signals, speed	None	Yes; number published to customers	$795; 1 year
	DCP3058, DCP3060; stand-alone	Multipoint (switched 56K bit/sec data unit); LDM (DCP3058)	2.4K, 4.8K, 9.6K, 19.2K, 56K bit/sec; 3 miles at 56K bit/sec over 19 AWG (DCP3058)	None; switched 56K bit/sec and subrates	Internal, external; external clock pin	RS-232, V.35; 4-wire, 2-wire (DCP3060)	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex; 2-wire (DCP3060): full duplex, half duplex, simplex	Serial binary, synchronous, asynchronous (DCP3060)	Diagnostic: loop-backs, test patterns; configuration: speed and operating mode	None	None	Yes; number published to customers	$1,950; 1 year
General DataComm, Inc. Middlebury, Conn. (203) 574-1118	500C/DBU-A, 500G, 500G/UXR; both	Point-to-point, multipoint; LDM	Model 500G/UXR: 2.4K to 64K bit/sec; 40,000 ft at 56K bit/sec over 22 AWG; Model 500C/DBU-A: 2.4K to 56K bit/sec; 44,000 ft at 56K bit/sec over 22 AWG	56K bit/sec DDS, 64K bit/sec; dial-up services (Model 500C/DBU-A)	Internal, external; from DTE or receiver wrap	RS-232, V.35, V.24, EIA-530 (Model 500G/UXR); 2-wire (Model 500C/DBU-A), 4-wire	DDS: full duplex, half duplex (Model 500G); 2-wire: full duplex (Model 500C); 4-wire: full duplex, half duplex, simplex (Model 500G)	Synchronous, asynchronous	Diagnostic: on, no signal, send data, RTS, CTS, data rate, carrier detect, line loop-backs, test mode, remote tests, secondary channel, high speed, low speed, terminal ready, modem ready, secondary channel send and receive (Model 500G), high and low speeds (Model 500C), modem ready (Model 500C); configuration: speed	Standard/Model 500G: 64K bit/sec operation, secondary channel, automatic adaptation to network speed, automatic adaptation to DDS I or DDS II networks; Model 500C: automatic or manual dial-backs and loop-backs, normal or extended range, synchronous or asynchronous operation, anti-streaming timer, callback phone number; optional: data rate adapter for speeds down to 1.2K bit/sec (Model 500G), EIA-530 interface (both models)	Standard: line loop-backs, remote digital loop-backs test, remote terminal tests, V.54 diagnostics (Model 500G), primary and secondary channel tests (Model 500G); optional: upgradable network management (Model 500G)	Yes; number published to customers	Model 500G: $1,045 rack-mountable, $1,095 stand-alone; Model 500C: $2,195; 1 year

AWG = American Wire Gauge
BERT = Bit error rate tester
CSU = Channel service unit
CTS = Clear to send
DDS = Digital data service
DSU = Data service unit
DTE = Data terminal equipment
EIA = Electronics Industries Association
LDM = Limited distance modem
LPDA = Link Problem Determination Aid
NA = Not applicable
RTS = Request to send
TDM = Time division multiplexer

FOOTNOTES:
(1) This chart lists only combined DSU/CSU units that operate up to and including 56K and 64K bit/sec. Fractional T-1 and T-1 DSU/CSUs are listed elsewhere. Like products are grouped as series; information listed for these covers entire range.
(2) Includes unit's ability to act as a limited-distance modem, if applicable.
(3) All units feature either LED or LCD displays. Some offer both; others offer external display jacks.

This chart includes a representative selection of 56K/64K bit/sec DSU/CSUs. These vendors may offer other DSU/CSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

56K/64K DSU/CSUs (continued on page 38)

Vendor	Product; type (stand-alone or rack-mountable) (1)	Configurations supported (2)	Data rates supported; top operating range	Services supported (dedicated; switched)	Clocking; source (internal, external; if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (3)	User-programmable features (standard; optional)	Network management/ diagnostics available (standard; optimal)	Telephone technical support; number	Price; warranty
General DataComm, Inc. Middlebury, Conn. (203) 574-1118	GDC Digidial; both	Point-to-point	56K bit/sec; NA	None; 56K bit/sec switched	Internal, external; from DTE or receiver wrap	V.35; 4-wire	4-wire: full duplex	Synchronous	Diagnostic: on, no signal, send data, RTS, CTS, carrier detect, line loop-backs, test mode, remote terminal test mode	Standard: auto-dial, auto-answer, manual dial, 801 AutoCall unit support; optional: card that allows an entire rack of Digidials to be controlled with one telephone	Standard: line loop-backs, self-tests, end-to-end self-tests	Yes; number published to customers	$2,350; 1 year
IBM White Plains, N.Y. (914) 288-3557	IBM 5822 Communications Network Management DSU/CSU; both	Point-to-point, multipoint; LDM	AT&T Publication 62310 rates; 14,500 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal, external; DTE, network	RS-232, V.35; 4-wire	DDS: full duplex, 4-wire: full duplex	Synchronous	Diagnostic: error codes, operation codes	None	Standard: LPDA-2 line status, LPDA-2 transmit/receive test	Yes; (919) 254-9141	$2,030; 1 year
Integrated Network Corp. Bridgewater, N.J. (908) 707-4905	CM-756 All-Rate DSU/CSU; both	Point-to-point; LDM	2.4K, 4.8K, 9.6K, 19.2K, 56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal, external; DTE and carrier service	V.35; 4-wire	DDS: full duplex	Synchronous, asynchronous	Diagnostic: loop-back status, BERT results	None	None	Yes; (800) 662-5515	$749; 1 year
	CM-1056 Switched and Dedicated DSU/CSU; both	Point-to-point, LDM	56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; 56K bit/sec	Internal, external; carrier service	V.35; 4-wire	DDS: full duplex, 4-wire: full duplex	Serial binary, synchronous	Diagnostic: loop-back status, BERT results; configuration: option setting indications	None	None	Yes; (800) 662-5515	$1,950 (desktop), $2,100 (rack-mountable); 1 year
	CM-1056E Switched and Dedicated DSU/CSU; both	Point-to-point; LDM	56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; 56K bit/sec	Internal, external; carrier service	V.35; 4-wire	DDS: full duplex, 4-wire: full duplex	Serial binary, synchronous	Diagnostic: loop-back status, BERT results; configuration: option setting indications	Standard: automatic dial backup	None	Yes; (800) 662-5515	$2,250 (desktop), $2,450 (rack-mountable); 1 year
	CM-1156; both	Point-to-point, LDM	56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; 56K bit/sec	Internal, external; DTE and carrier service	V.35; 4-wire	4-wire: full duplex	Serial binary, synchronous	Diagnostic: loop-back status, BERT results; configuration: option setting indications	Standard: automatic dial backup, automatic restoral	None	Yes; (800) 662-5515	$2,450 (desktop), $2,600 (rack-mountable); 1 year
Larse Corp. Santa Clara, Calif. (408) 988-6600	M/5600; both	Point-to-point; LDM	2.4K to 56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal, external; network	RS-232, V.35; 4-wire	DDS: full duplex; 4-wire: full duplex	Synchronous, asynchronous	Diagnostic: local loop-backs, digital loop-backs, remote loop-backs, test pattern, self-tests	Standard: disable front panel operations	None	Yes; (408) 988-6627	$715; 1 year
	SE-5600; both	Point-to-point; LDM	2.4K to 56K bit/sec; 18,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; 56K bit/sec switched	Internal, external; network	V.35; 4-wire	DDS: full duplex; 4-wire: full duplex	Synchronous	Diagnostic: local loop-backs, digital loop-backs, remote loop-backs, test pattern, self-tests; configuration: network status information	Standard: automatic dial backup, echo canceller disabler, memory dialing for as many as 25 numbers	Standard: remote operation via control port	Yes; (408) 988-6627	$2,475; 1 year
Micom Communications Corp. Simi Valley, Calif. (805) 583-8600	FrontRunner/ MR-1; both	Point-to-point	4.8K to 56K bit/sec; 15,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal	RS-232, V.35; 4-wire	DDS: full duplex; 4-wire: full duplex	Synchronous	Diagnostic: line status, line data rate, time of day, test loops, test pattern, hardware diagnostics; configuration: line data rate, network management system port data rate, time of day	Standard: network management system port, data rate	Standard: digital loop-back, test pattern generator, control signals display, central office control test	Yes; (800) 833-3282	$695 to $795; 3 years
	5000I/56-1 Marathon DSU/CSU; both	Point-to-point	56K bit/sec; 15,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal, external; network	RS-232; 4-wire	DDS: full duplex; 4-wire: full duplex	Synchronous	Diagnostic: line status, test loops, signal indicator, receive data, transmit data	None	Standard: local loop-backs, digital loop-backs, end-to-end test pattern, self-tests	Yes; (800) 833-3282	$750; 3 years
Motorola Codex Mansfield, Mass. (508) 261-4000	3500 Series DSU/CSU; both	Point-to-point, multipoint; LDM	2.4K to 56K bit/sec; 3.2 miles at 56K bit/sec used as LDM over 26 AWG	56K bit/sec DDS; 56K bit/sec	Internal, external; network or other device	RS-232, V.24, V.35; 4-wire	DDS: full duplex, half duplex	Synchronous, asynchronous	Diagnostic: line availability, status, test status, service codes, error-free seconds	Standard: line availability, status, test status, service codes, error-free seconds; optional: intelligent A/B switch, port sharing	Standard: line availability, status, test status, service codes, error-free seconds; optional: Codex DualView/IBM NetView	Yes; (800) 544-0062	$750 (nonmanaged model), $1,195 (managed model); 1 year
NEC America, Inc. San Jose, Calif. (800) 222-4632	NEC I5650; stand-alone	Point-to-point, multipoint, multidrop, tandem; LDM	2.4K to 56K bit/sec; 48,300 ft at 56K bit/sec over 19 AWG	56K bit/sec DDS; none	Internal, external; network sources	RS-232, V.24, V.28, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Synchronous, asynchronous	Diagnostic: local and remote tests, manual receive, send data, receive data, RTS, CTS, carrier detect, line alarms; configuration: data rate	Standard: remote configuration	Optional: NEC IC Management System	Yes; (800) 222-4632	$1,070; 1 year

AWG = American Wire Gauge
BERT = Bit error rate tester
CSU = Channel service unit
CTS = Clear to send
DDS = Digital data service
DSU = Data service unit
DTE = Data terminal equipment
EIA = Electronics Industries Association
LDM = Limited distance modem
LPDA = Link Problem Determination Aid
NA = Not applicable
RTS = Request to send
TDM = Time division multiplexer

FOOTNOTES:
(1) This chart lists only combined DSU/CSU units that operate up to and including 56K and 64K bit/sec. Fractional T-1 and T-1 DSU/CSUs are listed elsewhere. Like products are grouped as series; information listed for these covers entire range.
(2) Includes unit's ability to act as a limited-distance modem, if applicable.
(3) All units feature either LED or LCD displays. Some offer both; others offer external display jacks.

This chart includes a representative selection of 56K/64K bit/sec DSU/CSUs. These vendors may offer other DSU/CSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

56K/64K DSU/CSUs (continued from page 37)

Vendor	Product; type (stand-alone or rack-mountable) (1)	Configurations supported (2)	Data rates supported; top operating range	Services supported (dedicated; switched)	Clocking; source (internal, external; if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (standard; optional) (3)	User-programmable features (standard; optional) (3)	Network management/ diagnostics available (3) (standard; optional)	Telepone technical support; number	Price; warranty
NEC America, Inc. San Jose, Calif. (800) 222-4632	NEC N500A; stand-alone	Point-to-point, multipoint; LDM	2.4K to 56K bit/sec; 48,300 ft at 56K bit/sec over 19 AWG	56K bit/sec DDS; none	Internal, external; network sources	RS-232, V.24, V.28, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Synchronous, asynchronous	Diagnostic: test mode, power on/off, send data, receive data, request to send, clear to send; configuration: data rate	None	None	Yes; (800) 222-4632	$820; 1 year
Penril DataComm Networks Gaithersburg, Md. (301) 921-8600	DSU/CSU Series; both	Point-to-point, multipoint, multidrop; LDM	Line side: 9.6K, 19.2K, 56K bit/sec; DTE Side: 300 to 56K bit/sec; 17,000 ft at 56K bit/sec over 26 AWG	56K bit/sec DDS; none	Internal, external; DDS network	RS-232, V.24, V.28, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Serial binary, synchronous, asynchronous	Diagnostics: self-test, digital loop-backs, local loop-backs, remote loop-backs	Standard: synchronous and asynchronous operation, auto speed detect, speed buffering	None	Yes; (301) 921-8600	$467 to $867; 1 year
RAD Data Communications Rochelle Park, N.J. (201) 587-8822	ACD-1; stand-alone	Point-to-point, multipoint, multidrop; LDM	2.4K to 64K bit/sec; 20 miles at 64K bit/sec over 20 AWG	56K bit/sec DDS, 64K bit/sec; none	Internal, external; data communications equipment or DTE	RS-232, V.24, V.35; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Serial binary, synchronous	Diagnostic: loop-backs, pass/fail statistics, password; configuration: speed, DDS with secondary channel or standard DDS, downline load	Standard: standard DDS downline loading service type and data rate; optional: DDS with secondary channel	Standard: pass/fail tests, loop-backs	Yes; (201) 587-8822	$1,200 (ACD-1), $600 (ACD-1B); 1 year
UDS Motorola Huntsville, Ala. (205) 430-8000	D19.2; both	Point-to-point, multipoint; LDM	2.4K to 19.2K bit/sec; 71,000 ft at 19.2K bit/sec over 19 AWG	2.4K to 19.2K bit/sec DDS	Internal, external; DTE (in LDM mode)	RS-232; 4-wire, 2-wire	DDS: full duplex; 4-wire: full duplex; 2-wire: simplex	Serial binary, synchronous, asynchronous	Diagnostic: test mode, no signal, test pattern/ errors, out of service	Standard: data rate, transmitter timing option, synchronous and asynchronous operation, remote loop-backs, bilateral loop-backs, streaming terminal disconnect, DTE test options	Standard: end-to-end test with pattern, local and remote loop-backs, remote terminal loop-backs, loop-backs with test pattern	Yes; (205) 430-8000	$595; 1 year
	D56; both	Point-to-point, multipoint; LDM	52,800 ft at 56K bit/sec over 19 AWG	56K bit/sec DDS; none	Internal, external; DTE (in LDM mode)	V.35; 2-wire, 4-wire	DDS: full duplex; 4-wire: full duplex; 2-wire: simplex	Serial binary, synchronous	Diagnostic: test pattern, test mode, clear to send, power on, receive data, send data, out of service, network signal	Standard: RTS timing, DTE test input, loop-back enable	Standard: local and remote loop-backs, remote terminal loop-backs, test pattern, local and remote loop-backs with test pattern	Yes; (205) 430-8000	$695; 1 year
	DDS/MR1; both	Point-to-point, multipoint; LDM	1.2K to 64K bit/sec; 54,000 ft at 64K bit/sec over 19 AWG	2.4K to 19.2K bit/sec DDS, 56K bit/sec DDS; none	Internal, external; DTE (in LDM mode)	RS-232, DB-25; 4-wire	DDS: full duplex; 4-wire: full duplex	Serial binary, synchronous, asynchronous	Diagnostic: data rate, clear to send, network signal, out of service, test status, receive data, send data; configuration: clock source, synchronous and asynchronous operation, RTS control, autobaud enable, bits per word, RTS/CTS delay, DTE tests enable	Standard: data rate, elastic buffer enable, data set ready control	Standard: network status, local and remote loop-back tests, DTE tests	Yes; (205) 430-8000	$695; 1 year
	DDS/V.32; both	Point-to-point, multipoint; LDM	1.2K to 64K bit/sec; 54,000 ft at 64K bit/sec over 19 AWG	2.4K to 19.2K bit/sec DDS, 56K bit/sec DDS; none	Internal, external; DTE	RS-232, V.35, EIA-530, DB-25; 4-wire	DDS: full duplex; 4-wire: full duplex	Serial binary, synchronous, asynchronous	Diagnostic: data rate, test mode, network signal, transmit data, out of service, CTS, receive data, test status; configuration: clock source, synchronous and asynchronous operation, RTS control, autobaud enable, bits per word, DTE tests enable, loop-back options, RTS/CTS delay	Standard: data rate, elastic buffer enable, data set ready control	Standard: network status, local and remote loop-backs tests, DTE tests, elastic buffer enable; optional: NA	Yes; (205) 430-8000	$1,895; 1 year
	DU100, both	Switched point-to-point	300 bit/sec, 1.2K, 2.4K, 4.8K, 9.6K, 19.2K, 56K, 64K bit/sec; 64K bit/sec at 18,000 ft over 22 AWG	NA; 56K, 64K bit/sec	Internal	RS-232, V.24, V.28, V.35, EIA-449, EIA-530; 2-wire	2-wire: full duplex, simplex	Serial binary, synchronous, asynchronous	Diagnostic: test mode, receive data, data rate, data terminal ready, CTS, transmit data, call progress indication, network signal, test status; configuration: data rate, timing source, RTS, CTS, data set ready, DCD, data terminal ready, auto answer, auto call enable, echo cancellor tone enable, keyboard dial enable, synchronous-asynchronous	Standard: Northern Telecom Symbolic Dialer, speed call options, integral AT dialer; optional: NA	Local and remote loop-backs, loop-backs with test pattern, remote terminal loop-backs; optional: NA	Yes; (205) 430-8000	$1,095; 1 year
	DU100LS; stand-alone	Switched point-to-point	300 bit/sec, 1.2K, 2.4K, 4.8K, 9.6K, 19.2K bit/sec; 19.2K bit/sec at 18,000 ft over 22 AWG	NA; none	Internal	RS-232; 2-wire	2-wire: full suplex, simplex	Serial binary, asynchronous	Diagnostic: transmit data, receive data, RTS, test mode, power, CTS, network signal, data terminal ready; configuration: NA	Standard: integral AT dialer, Northern Telecom Symbolic Dialer; optional: NA	Standard: local and remote loop-backs; optional: NA	Yes; (205) 430-8000	$695; 1 year

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BERT = Bit error rate tester
CSU = Channel service unit
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DDS = Digital data service
DSU = Data service unit
DTE = Data terminal equipment
EIA = Electronics Industries Association
LDM = Limited distance modem
LPDA = Link Problem Determination Aid
NA = Not applicable
RTS = Request to send
TDM = Time division multiplexer

FOOTNOTES:
(1) This chart lists only combined DSU/CSU units that operate up to and including 56K and 64K bit/sec. Fractional T-1 and T-1 DSU/CSUs are listed elsewhere. Like products are grouped as series; information listed for these covers entire range.
(2) Includes unit's ability to act as a limited-distance modem, if applicable.
(3) All units feature either LED or LCD displays. Some offer both; others offer external display jacks.

This chart includes a representative selection of 56K/64K bit/sec DSU/CSUs. These vendors may offer other DSU/CSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

T-carrier DSUs (continued on page 42)

Vendor	Product; type (stand-alone or rackmountable)	Configurations supported (1)	Data rates supported; top operating range	Services supported (dedicated; switched)	Clocking (internal, external); source (if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (2)	User-programmable features (standard; optional)	Network management/diagnostics (standard; optional)	Telephone technical support; number	Price; warranty
ADC Kentrox Portland, Ore. (800) 733-5511	DataSMART T-1 IDSU; both	Point-to-point; LDM	Nx56K or Nx64K bit/sec, up to 1.544M bit/sec; 50 ft at 1.536M bit/sec over 19 to 26 AWG	T-1, fractional T-1; none	Internal, external; network or other external 1.544M Hz source	V.35, EIA-530, DS1; 4-wire	4-wire: full duplex	Synchronous	Diagnostic: loop, far end loop, test code active, alarm	Standard: all software features are user-programmable via ASCII terminal; optional: ZBTSI	Standard: local and remote configuration, BERT; optional: ADC MultiSMART Manager, IBM NetView	Yes; (800) 733-5511	$2,995 to $4,495; 2 years
	DataSMART 45, DataSMART SMDSU 45; both	Point-to-point; LDM	44.2M bit/sec; 450 ft at 44.2M bit/sec over 28 AWG or 7 strands of 36 AWG	T-3; NA	Internal	HSSI; BNC DSX3	75-ohm BNC full duplex	Serial binary	Diagnostic: line and payload loop codes, self-tests, activation and indication of loop codes, alarms, dataport handshaking, monitor ports; configuration: framing format, LBO, communications parameters, clocking	Standard: loopback codes, HSSI data port; optional: framing formats, user identification and passwords, alarm options, performance registers, LBO, control port communications	Standard: ASCII format user interface; optional: ADC MultiSMART Manager, IBM NetView PC	Yes; (800) 733-5511	$11,000 (DataSMART 45), $14,950 (SMDSU 45); 2 years
Astrocom Corp. St. Paul, Minn. (612) 227-8651	NXI T-1/FT-1 DSU/CSU; both	Point-to-point, multipoint; LDM	1.544M bit/sec composite; 6,000 ft at 1.544M bit/sec over 22 AWG	T-1, fractional T-1; none	Internal, external; network, DTE	V.35, RS-422/449; 4-wire, DB-15	4-wire: full duplex	Synchronous	Diagnostic: loop-backs performed from front panel; configuration: network configuration monitoring	None	Standard: Local, digital and remote loop-backs, ESF diagnostic information, AT&T 4016 and ANSI T1.403 interfaces	Yes; (612) 227-8651	$1,995; 2 years
Coastcom, Inc. Concord, Calif. (415) 825-7500	T1M III; both	Point-to-point, multipoint, multidrop; LDM	Up to 1.536M bit/sec; 12,000 ft at 56K bit/sec or 15 ft at 1.536M bit/sec	56K bit/sec DDS, 64K bit/sec fractional T-1, T-1; 56K bit/sec	Internal, external; T-1 line, customer data line, any external clock that is a multiple of 1600Hz between 8KHz and 1.544MHz, stratum 4	RS-232, V.35, RS-422; 4-wire, T-1	4-wire: full duplex, simplex	Synchronous, asynchronous	Diagnostic: local alarm, CGA, remote alarm, framing error, bit 7 stuffing to meet density, bipolar violation, all zeros, all ones, set, power, ring, test; configuration: alarm cutoff, bypass, channel loop-backs, network loop-backs	Standard: T-1 port assignments, test modes, CGA support, data speed, secondary channel support, change map of DS0 assignments in alarm or event; optional: PC-based programmability with graphical user interface	Standard: card type, card location, software revision, DSU reset; optional: network map, auto dialing, AT&T Accumaster interface, ESF/FDL monitoring	Yes; (415) 825-7500	$5,200 for 4 56K bit/sec circuits; 2 years
Cylink Corp. Sunnyvale, Calif. (408) 735-5800	4201 T-1, 4202 FT-1 Advanced Channel Services Units; both	Point-to-point; LDM	Nx56K or Nx64K bit/sec, up to N=24; 6,000 ft at 1.544M bit/sec over 24 AWG	T-1, fractional T-1 (4202 only); none	Internal, external; DTE, station clock	V.35, DS1, RS-422/449; DS1/T-1	4-wire: full duplex	Synchronous	Diagnostic: alarm status, loop-backs, BERT/QRSS	Unit is fully programmable	Standard: Cylink Network Management System, BERT/QRSS, loop-backs	Yes; (800) 545-6608	$3,000 for basic unit; 2 years
Digicom Systems, Inc. Milpitas, Calif. (800) 833-8900	5664N FT-1 DSU/CSU; both	Point-to-point; LDM	Nx56K or 64K bit/sec, up to N=24; 6,000 ft at 1.536M bit/sec over 22 AWG	T-1, fractional T-1; T-1	Internal, external; network, DTE	V.35, DS1 port, RS-449; 4-wire	4-wire: full duplex	Serial binary, synchronous	Diagnostic: general diagnostic information (see network management entry); configuration: all network configuration parameters	Standard: B8ZS or AMI line code, D4 or ESF framing, user-defined time slot allocation, selectable timing and data rates	Standard: storage of 24-hour network performance data, local and remote loop-backs	Yes; (800) 833-8900, (408) 262-1277	$2,850; 2 years (limited)
Digital Link Corp. Sunnyvale, Calif. (408) 745-6200	DL551V II and DL551V IIM; both	Point-to-point; LDM	1.344M to 1.544M bit/sec; 655 ft at 1.544M bit/sec over 22 AWG	T-1; T-1	Internal, external; T-1 network	V.35, EIA-530; T-1	T-1	Synchronous	Diagnostic: power, DTE loop-backs, network loop-backs, frame errors, frame loss, bipolar violations, cyclic redundancy check-6, transmit data, receive data, request to send, clear to send	Standard: line code (B8ZS, AMI), D4 or ESF framing, HDLC or scrambler encoding mode, LBO	Standard: DTE loop-backs, network loop-backs	Yes; (408) 745-6200	$2,295; 2 years
	DL200 SMDS Converter; both	Point-to-point; LDM	1.544M bit/sec; 655 ft at 1.544M bit/sec over 22 AWG	T-1; T-1	Internal	V.35, RS-449, EIA-530; T-1	T-1	Synchronous	Diagnostic: ESF performance data, DTE and network status/alarms	Standard: clock source, encoding method, DACS/non-DACS operation, communications port configuration	Standard: DTE loop-backs, network loop-backs, test pattern generator/detector (1:3 and 1:5 test patterns), interface to Digital Link Network Management System	Yes; (408) 745-6200	$6,195; 2 years
Dowty Communications, Inc. (formerly CASE/Datatel, Inc.) Cherry Hill, N.J. (800) 227-3134	DCP3551; stand-alone	Point-to-point; LDM	1.544M bit/sec; 6,000 ft at 1.544M bit/sec over 19 AWG	T-1, fractional T-1; none	Internal, external; network, DTE (via clock jack)	T-1; 4-wire	T-1	T-1	None	None	None	Yes; number published to customers	$1,750; 1 year
General DataComm, Inc. Middlebury, Conn. (203) 574-1118	DataComm 552 Fractional T-1 DSU; both	Point-to-point; LDM	1.544M bit/sec; 6,300 ft at 1.544M bit/sec over 22 AWG	Fractional T-1; none	Internal, external; DTE or receiver wrap	V.35, 4-wire	4-wire: full duplex	Synchronous, asynchronous	Diagnostic: power on, out of frame, no signal, loop-backs, bipolar violation, alarm indication signal, network error, test mode, cascade out of frame, cascade active, send data, receive data, configuration error, channel selection, alarm counts, 1-hr reports, 24-hr reports, scheduled performance reports; configuration: various channel and CSU configuration details, including alarm polling	Standard: supervisory port, D4 or ESF format (AT&T and ANSI), AMI and B8ZS encoding; optional: EIA-530 interfaces, cascade port, data rate adapter for operation down to 2.4K bit/sec	Standard: supervisory port, front panel jacks, others listed under "Information displayed"; optional: performance monitoring card allows the monitoring of an entire network of DataCom 552s	Yes; number published to customers	$2,995 to $4,500; 1 year

AMI = Alternate mark inversion
AWG = American Wire Gauge
B8ZS = Binary 8-zero suppression
BERT = Bit error rate tester
CGA = Carrier group alarm
CSU = Channel service unit
DACS = Digital access and cross-connect
DCE = Data communications equipment
DSU = Data service unit
DTE = Data terminal equipment
EIA = Electronics Industries Association
ESF = Extended superframe format
FDL = Facility data link
HDLC = High-level Data Link Control
HSSI = High-speed serial interface
LBO = Line build-out
LDM = Limited-distance modem
NA = Not applicable
QRSS = Quasi-random signal source
SMDS = Switched Multimegabit Data Service
ZBTSI = Zero byte time slot interchange

FOOTNOTES:
(1) Includes unit's ability to act as a limited-distance modem, if applicable.
(2) All units feature either LED or LCD displays. Some offer both; other offer external display jacks.

This chart includes a representative selection of T-carrier DSUs. These vendors may offer other T-carrier DSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

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T-carrier DSUs (continued from page 39)

Vendor	Product; type (stand-alone or rackmount-able)	Configura-tions supported (1)	Data rates supported; top operating range	Services supported (dedi-cated; switched)	Clocking (internal, external); source (if external)	Interfaces (terminal; line)	Operating modes	Data formats supported	Information displayed (diagnostic; configuration) (2)	User-programmable features (standard; optional)	Network manage-ment/diagnostics (standard; optional)	Telephone technical support; number	Price; warranty
Infotron Systems Corp. Cherry Hill, N.J. (609) 424-9400	DL100/ DL551/ N500A; both	Point-to-point, multipoint, multidrop; LDM (N500A only)	Up to 1.544M bit/sec, 45M bit/sec	56K bit/sec DDS, 64K bit/sec, fractional T-1, T-1, T-3; 56K, 64K, 384K bit/sec, T-1	Internal, external; DTE, network	V.35, RS-449; 4-wire	DDS (N500A): full duplex; 4-wire: full duplex	Serial binary, syn-chronous, asynchro-nous	Diagnostic: power, network status, loop status, DTE status, set/reset, data/test; configuration: all network configuration information via front panel or ASCII-compatible RS-232 communications port	Standard: AMI, B8ZS or bipolar return-to-zero line codes, D4 or ESF framing, keep-alive signal to T-1 net; optional: scrambler, HDLC	Standard: T-1 loop and code control, DTE loop-backs and code control, self-tests; optional: Sun Microsystems, Inc. SPARCstation-based network management system	Yes; (800) 759-9999	$1,295 (CSU only) to $3,615 (dual input CSU with fractional T-1); 1 year
Racal-Vadic Corp. Milpitas, Calif. (800) 482-3427	FT1/DSU; both	Point-to-point	1.544M bit/sec	T-1, fractional T-1; none	Internal, external; RS-422 compatible inputs	V.35, RS-449/422; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: monitor and tests of all functions except ESF, network configuration, monitoring and test monitoring, local and remote loop-back tests, alarms; configuration: line parameter settings, DS0 allocations, clock timing source, user port parameters	None	Standard: ESF diagnostics	Yes; (408) 922-3350	$3,995, $495 for multiplexer chassis; 1 year
RAD Data Communications Rochelle Park, N.J. (201) 587-8822	FCD-1; both	Point-to-point, multipoint; LDM	Nx56K or Nx64K bit/sec, up to 1.544M bit/sec	T-1, fractional T-1; T-1, 384K bit/sec	Internal, external; DCE or DTE	RS-232, V.35, RS-422/449; 4-wire	DDS: full duplex, half duplex; 4-wire: full duplex, half duplex, simplex	Serial binary, syn-chronous	Diagnostic: remote line diagnostics, alarms, loop-backs, pass/fail; configuration: data rate, time slot (consecutively or alternately)	Standard: selectable time slots, rate selection (Nx56K or Nx64K bit/sec); optional: terminal access, RS-422/449 or X.21 interface	Standard: out-of-band management, 24-hour storage of diagnostic information; optional: terminal access, dial-out feature	Yes; (201) 587-8822	$1,500 (FCD-1M), $2,000 (FCD-1X); 1 year
Scitec Communications Systems, Inc. Middletown, R.I. (800) 343-0928	IBM-FT1; both	Point-to-point, multipoint, multidrop; LDM	Nx56K or Nx64K bit/sec; 680 ft at 1.544M bit/sec over 22 AWG	T-1, fractional T-1; none	Internal, external; line and channel	V.35, RS-422; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: remote/local loop-backs, channels and trunk; configuration: set all operation	Standard: all unit features	Standard: all unit features	Yes; (800) 343-0928	$2,900; 1 year
	Integrator 1544; both	Point-to-point; LDM	Nx64K bit/sec; 680 ft at 1.344M bit/sec over 22 AWG	T-1; none	Internal, external; line, network	V.35, RS-422; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: remote/local loop-backs, channels and trunk; configuration: set all operation	None	None	Yes; (800) 343-0928	$2,600; 1 year
TyLink Corp. Norton, Mass. (508) 285-0033	ONS 150; both	Point-to-point, multipoint; LDM	56K to 1.544M bit/sec; 6,000 ft at 1.544M bit/sec over 22 AWG	T-1, fractional T-1, 64K bit/sec; none	Internal, external; line, DTE, network	V.35, RS-422, EIA-530; 4-wire	4-wire: full duplex	Synchro-nous	Basic configuration and management information	Standard: DSU or DSU/CSU option, contiguous or alternate DS0 format, AMI or B8ZS operation	Standard: local and remote channel loop-backs, local and remote aggregate loop-backs, front panel LEDs	Yes; (508) 285-0033	$1,495; 1 year
	ONS 400, 400PRI, 400FR; both	Point-to-point, multipoint; LDM	2.4K to 1.544M bit/sec (400FR: 256K to 1.024M bit/sec); 6,000 ft at 1.544M bit/sec over 22 AWG	T-1, fractional T-1, 64K bit/sec (400FR: WilTel WilPak frame relay); none	Internal, external; DTE, network, station clock	V.35, RS-422, EIA-530, T-1/PBX; 4-wire	4-wire: full duplex	Synchro-nous	Diagnostic: 511 BERT test results, ESF performance; configuration: aggregate and channel configuration	Standard: D4 or ESF framing, DSU or DSU/CSU operation, AMI or B8ZS coding, contiguous or alternate DS0 format; optional: 2 or 4 DTE channels	Standard: internal 511 BERT tester, local and remote channel loop-backs and aggregate loop-backs, ESF performance monitoring; optional: microcomputer-based network management	Yes; (508) 285-0033	$2,750 (400, 400FR), $5,500 (estimated price for 400PRI, available fourth quarter, 1991); 1 year
Verilink Corp. San Jose, Calif. (408) 945-1199	ConnecT1, ConnecT FT1, ConnecT1 Plus; both	Point-to-point, multipoint (ConnecT1 Plus)	Nx56K or Nx64K bit/sec, up to 1.536M bit/sec	T-1, fractional T-1; none	Internal, external; standard T-1 sources	V.35, EIA-530; 4-wire (DSX1)	4-wire: full duplex, half duplex (ConnecT1 Plus)	Synchro-nous	Diagnostic (ConnecT1 and ConnecT FT1): channel load staus, loop-back load status; configuration: loop-back selection per channel	Standard: T-1 drop and insert (ConnecT1 Plus)	Standard: Verilink Verinet 2 Management System (ConnecT1 Plus)	Yes; number published to customers	$2,595 (ConnecT1), $2,750 (ConnecT FT1), $4,395 (ConnecT1 Plus); 1 year

AMI = Alternate mark inversion
AWG = American Wire Gauge
B8ZS = Binary 8-zero suppression
BERT = Bit error rate tester
CGA = Carrier group alarm
CSU = Channel service unit
DACS = Digital access and cross-connect
DCE = Data communications equipment
DSU = Data service unit
DTE = Data terminal equipment
EIA = Electronics Industries Association
ESF = Extended superframe format
FDL = Facility data link
HDLC = High-level Data Link Control
HSSI = High-speed serial interface
LBO = Line build-out
LDM = Limited-distance modem
NA = Not applicable
QRSS = Quasi-random signal source
SMDS = Switched Multimegabit Data Service
ZBTSI = Zero byte time slot interchange

FOOTNOTES:
(1) Includes unit's ability to act as a limited-distance modem, if applicable.
(2) All units feature either LED or LCD displays. Some offer both; other offer external display jacks.

This chart includes a representative selection of T-carrier DSUs. These vendors may offer other T-carrier DSUs, and other vendors not included may offer a full range of products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

(continued from page 35)

One item that many customers take for granted — and which is included in the charts — is the ability of DSU/CSUs to operate at multiple data rates. In fact, few users buy a unit designed to operate at just one data rate.

The final purchase criterion is price, or, more accurately, what device will fulfill your needs at the lowest price.

The comparison charts provide list price — or, for product series, price ranges — along with comparative information on data rates, interfaces, operating modes, carrier services supported, network management/diagnostics and other features.

Another important note about the charts: Where a series of products appears in the listing, the features listed are not always common to all products in the series. Where possible, we have separated features by individual products, but users should confirm feature-by-feature availability of each product with the vendor.

Summing it up

The past six years have featured ongoing, tremendous changes in the development of DSU/CSUs, and it is likely that the next six will see even more.

Some of the things we are likely to see include further integration of DSU/CSU functionality into other customer premises equipment, especially into multiplexers; increased automation in diagnostics and interfaces with local telephone company switches; and the advancement of 2-wire technology to accompany the growing spread of switched digital services.

With this, we can expect more incorporation of high-speed modem backup features into DSU/CSUs and, of course, increased price competition.

What users need to hope for is that, with all the increased functionality, vendors do not compromise compatibility with other vendors' products.

The last thing users want to build their networks around is a bunch of multifunctional technological marvels that cannot talk to one another.

Letters

continued from page 27

the total free bandwidth of the WAN (currently as high as T-1 in the U.S.). It is also faster because the smaller fixed-length cells into which the IPX divides frame relay packets can already be arriving at their destination while the end of the frame relay packet is still being sent from the router.

If the IPX did indeed transmit variable-length packets, it would have to wait until the entire frame had been accepted into the switch before sending it.

Brian Button
Manager of product marketing
StrataCom, Inc.
Campbell, Calif.

Editor's response: The error in question was inadvertently introduced during editing. Network World *regrets this.*

Cultivating high-speed nets

CONTINUED FROM PAGE 1
tions. Some projects, particularly Aurora, focus primarily on network architecture issues. Others, such as Casa and Vistanet, explore engineering and the possibility of optimizing applications suited to multigigabit networks. (see "Following in the footsteps of ARPANET," page 45).

Diverse NREN-related research concerns made it appropriate for the NSF to fund five test beds rather than one, according to Darleen Fisher, associate director of NSF's Networking and Communications Research Program, who oversees the projects. "Geographically, it makes sense to spread them around the country," she says.

NSF wanted multiple participants in the projects to share the costs, tap the best minds in industry and academia, and explore diverse research topics.

"It would be too expensive to have one nationwide test bed," Fisher says (see "NREN fiscal and political prospects," page 45).

So far, research is in an exploratory stage at all five projects. None of the test beds has yet implemented an operational multigigabit WAN. However, most plan to do so by year end. This article will discuss each test bed's research and implementation plans. (For an overview of test bed participants, sites, technologies and research topics, see chart "Gigabit network test beds," page 44.)

Uncle Sam invests in the future with five multigigabit network test beds.

Aurora

When operational, the Aurora network will link four research sites in the Northeast: IBM's Thomas J. Watson Research Center in Hawthorne, N.Y.; Bell Communications Research's Morristown Research and Engineering Laboratory in Morristown, N.J.; the Massachusetts Institute of Technology's Laboratory for Computer Science in Cambridge, Mass.; and the University of Pennsylvania's Distributed Systems Laboratory in Philadelphia (see Figure 1 on page 44).

Test participants will begin sending data over Aurora when high-speed fiber transmission facilities become available from participating carriers Bell Atlantic Corp., MCI Communications Corp. and Nynex Corp. This may be possible by year end, according to Alan Baratz, leader of Aurora's IBM research team.

Experimental 622M bit/sec, Synchronous Optical Network (SONET) Optical Carrier 12 (OC-12) fiber links from these three companies will connect the research sites.

Perhaps the most important aspect of Aurora will be the face-off between two experimental high-speed switching technologies: Bellcore's Sunshine switch, which uses asynchronous transfer mode (ATM), and IBM's Packetized Automatic Routing Integrated System (PARIS), which uses packet transfer mode.

ATM switches handle digital information in the form of small, fixed-size cells. By contrast, the packet transfer mode approach deals with variable-length packets. Cells are normally considered to fall on Layer 2 of the Open Systems Interconnection model, while packets convey the greater functionality of Layer 3.

These switches are similar in that they both perform most

(continued on page 44)

Kobielus, a contributing editor to Network World, *is a telecommunications analyst with Fairfax, Va.-based Network Management, Inc.*

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Gigabit network test beds

Project	Network nodes, research sites	Participating carriers	Research topics, technologies	Applications
Aurora	Bell Communications Research, Morristown, N.J.; IBM, Hawthorne, N.Y.; Massachusetts Institute of Technology, Cambridge, Mass.; University of Pennsylvania, Philadelphia	Bell Atlantic Corp., MCI Communications Corp., Nynex Corp.	ATM, distributed virtual memory, high-speed protocols, network architectures, network operation and management, network resource control and allocation, packet-transfer mode switching, traffic modeling	Broadband network applications, business and scientific applications, virtual laboratory
Blanca	Astronautics, Madison, Wis.; AT&T Bell Laboratories, Murray Hill, N.J.; Cray Research, Inc., Minneapolis; Lawrence Berkeley Laboratories, Berkeley, Calif.; National Center for Supercomputing Applications, Champaign-Urbana, Ill.; University of California-Berkeley; University of Illinois, Champaign-Urbana; University of Wisconsin-Madison	AT&T, Norlight, RBHCs	Burst handling, fast call setup, high-speed channels, multiplexing strategies, network virtual memory, real-time communications, switch design, traffic models	Medical imaging, multimedia digital libraries, multiple remote visualization and control of simulations, radio astronomy imaging
Casa	California Institute of Technology, Pasadena, Calif.; Jet Propulsion Laboratory, Pasadena; Los Alamos National Laboratory, Los Alamos, N.M.; San Diego Supercomputer Center, San Diego	MCI, Pacific Bell, US West, Inc.	HPPI, metacomputer, multiprocessing, parallel programming, SONET	Chemical reaction dynamics, climate modeling, interactive data analysis and visualization of geologic models
Nectar	Bellcore; Carnegie-Mellon University, Pittsburgh; Pittsburgh Supercomputing Center, Pittsburgh	Bell Atlantic	High-speed protocols, operating systems, parallel programming environments	Large combinatorial optimizations, process flow-sheeting
Vistanet	North Carolina Supercomputing Center, Research Triangle Park, N.C.; University of North Carolina-Chapel Hill	BellSouth Corp., GTE Telephone Operations	ATM, broadband circuit switching, high-speed protocols, HPPI, SONET, traffic models	Dispersed collaboration, radiation treatment therapy planning

ATM = Asynchronous Transfer Mode
HPPI = High Performance Parallel Interface
SONET = Synchronous Optical Network

SOURCE: NETWORK MANAGEMENT, INC., FAIRFAX, VA.

(continued from page 43)
switching functions in specialized hardware, as opposed to the software-intensive designs of traditional packet switches.

engineered to support the integrated streams of voice, data, image and video traffic expected over multigigabit networks.

A switch's performance will be measured by its ability to support various quality of service (QOS) profiles associated with these applications. Critical QOS parameters include bandwidth, bit error rate, delay, delay variability, packet loss, packet duplication and packet misordering.

An open question Aurora researchers are addressing is whether a single switching fabric can do justice to diverse QOS traffic requirements, says David Clark, senior research scientist in MIT's Laboratory for Computer Science. QOS requirements can differ sharply between traffic types.

For example, real-time voice and video transmissions can tolerate some packet losses and errors but are intolerant of propagation delays and require a guaranteed, consistent allocation of bandwidth. Data file transfers, by contrast, can usually tolerate reasonable delays in exchange for error-free transmission.

The most troublesome traffic, from the point of view of network design, may be bursty applications, such as graphic supercomputer visualization, since these have large, unpredictable bandwidth requirements and tolerate few errors and packet losses. If not managed correctly, bursty data streams could eat up most network transmission and switching capacity and choke off other traffic.

Bellcore and IBM use different switch designs, implemented in specialized circuitry, to support bursty traffic. Bellcore's Sunshine switch incorporates a highly parallel, Batcher-banyan cell-relay fabric.

This fabric efficiently sorts incoming fixed-length cells by QOS priority, routes them to output queues and recirculates for subsequent transmission cells that, due to low priority and momentary switch overloads, failed to find output queues in the previous time slot. Bursty transmissions can be assigned their own dedicated set of output queues.

Sunshine's Batcher-banyan architecture uses two types of internal, interconnected switching fabrics: Batcher sorting networks and banyan routing networks.

Batcher networks receive incoming cells from input port controllers, sort the cells based on their control headers and arrange them by QOS priority. The cells are then handed off to banyan networks, which route them to output queues associated with the switch's output port controllers. The output port controllers terminate the banyan networks, provide cell buffers and drive the transmission links.

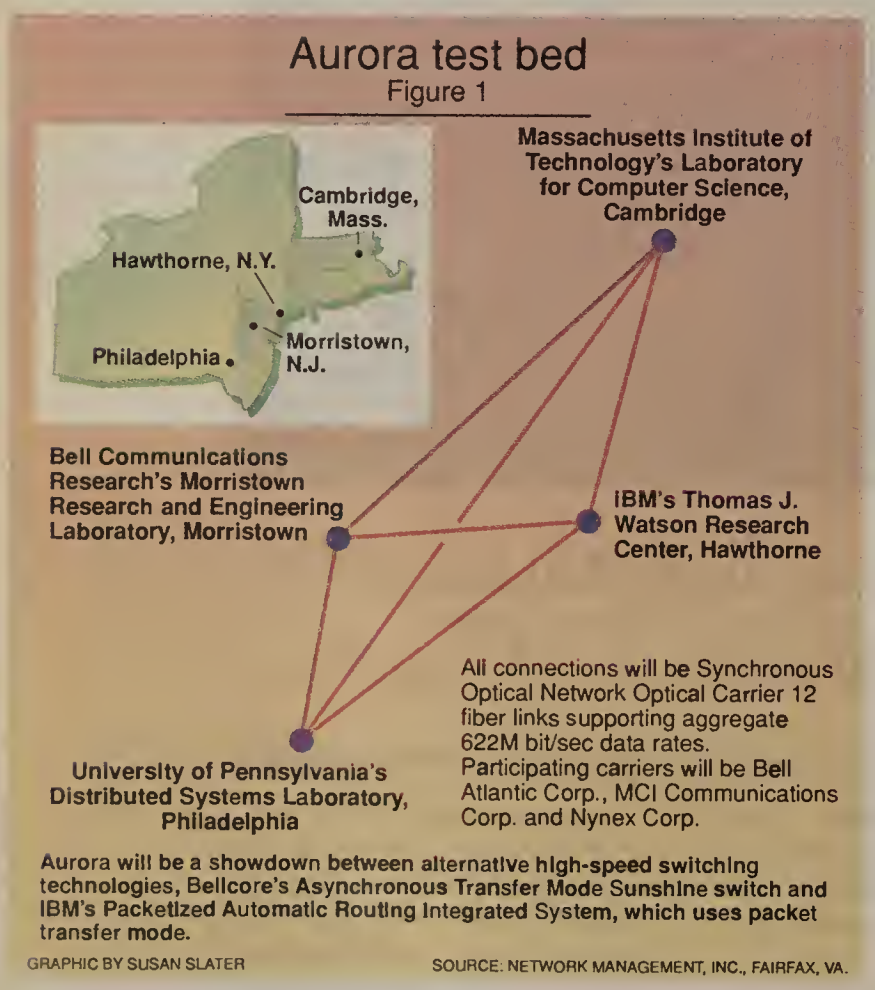
This architecture furnishes bursty transmissions with necessary on-demand bandwidth, ensures that lower priority traffic receives adequate service and minimizes the likelihood of lower priority cells being dropped due to switch overloads.

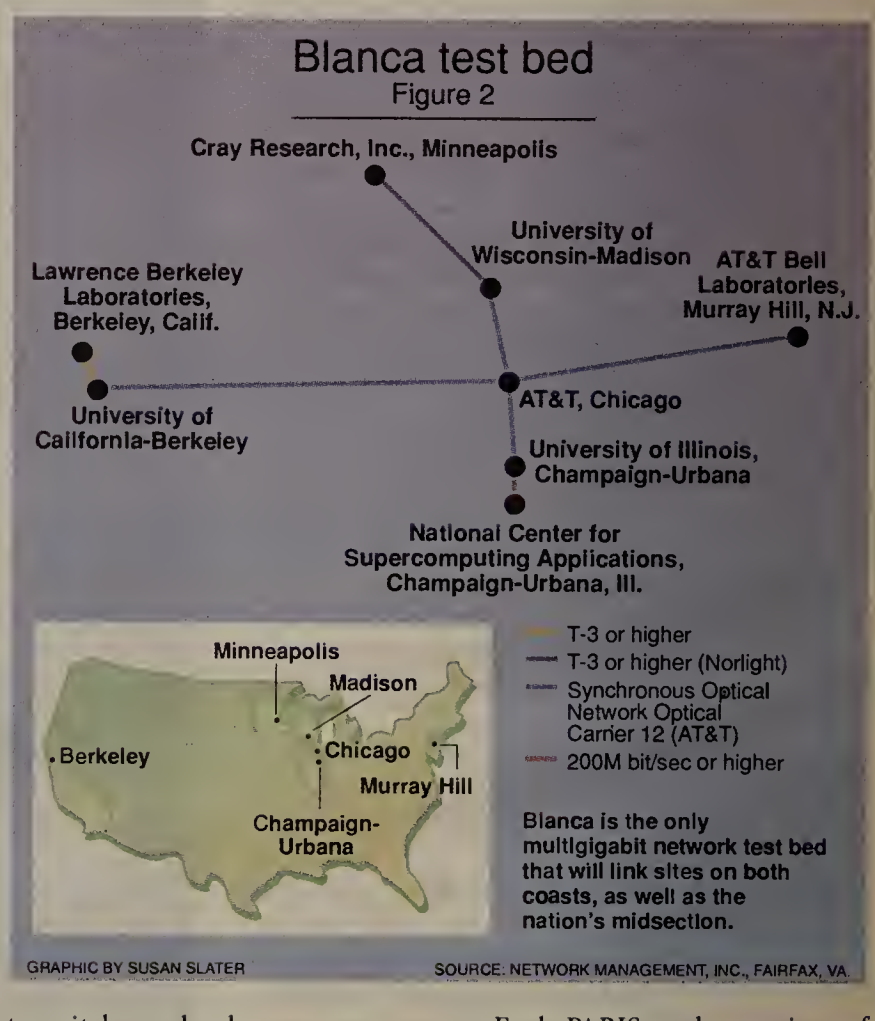
IBM's PARIS architecture handles functions such as error recovery and flow control on an end-to-end basis. This allows PARIS to use bandwidth and handle bursty traffic more efficiently by streamlining the amount of protocol processing performed by network switches.

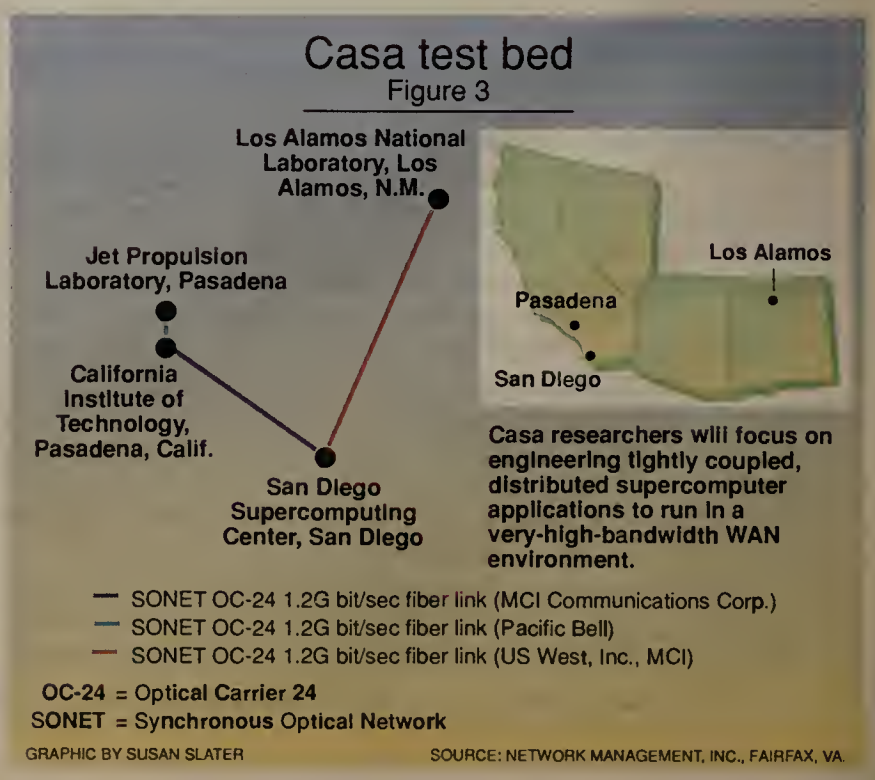
The originating computer specifies the entire network route that a variable-length packet will travel, thereby eliminating the need for intermediate switches to perform processor-intensive routing table lookups. In traditional packet-switched networks and systems incorporating ATM switches, these functions are handled on a hop-to-hop basis.

In the Aurora network, IBM will deploy PARIS switching nodes that each support an aggregate throughput of 6G bit/sec — equivalent to 10 million packets per second — over six 1G bit/sec transmission lines, IBM's Baratz says. Internal propagation delay between input and output ports on each PARIS switch is less than 1 msec, he adds.

Each PARIS node consists of end-point processors, which interface to the network, perform packetization and reassembly, flow control and error recovery;







Following in the footsteps of ARPANET

To lay the groundwork for the National Research and Education Network (NREN), the five test beds are exploring advanced switch designs, protocol implementations and network interfaces. Most likely, these developments will find applications in commercial and private networks as well.

In this way, NREN will follow in the footsteps of its ancestor, the Advanced Research Projects Agency Network (ARPANET), which 20 years ago pioneered packet-switching architectures and protocols that now support computer communications worldwide.

However, NREN will differ from ARPANET in two ways. First, NREN will probably support a wider range of switch architectures, including some combination or synthesis of fast packet, cell relay and broadband Integrated Services Digital Network switching. One switch being tested is even based on fast circuit switching.

Second, NREN is intended to support the entire range of electronic communications and distributed data processing traffic, including voice, interactive data, facsimile, full-motion videoconferencing, real-time output and display of graphical simulations (such as for molecular and atmospheric modeling), which are generated by supercomputers, and a host of multimedia applications. The network will use fiber-optic lines and high-speed switches capable of integrating these diverse traffic types.

To date, NREN-related research has proceeded more slowly than its proponents would like, largely due to federal funding limitations. The five test bed projects are sharing a three-year, $15.8 million grant from the National Science Foundation (NSF) and the Defense Advanced Research Projects Agency (DARPA). Work on the test beds, some of which predate the NSF/DARPA grant by several years, is being overseen for the federal sponsors by the nonprofit Corporation for National Research Initiatives in Reston, Va.

— James Kobielus

switching subsystems, which route packets from input to output ports and perform buffering, prioritization and congestion control; and network control units, which perform node control functions and gather traffic statistics.

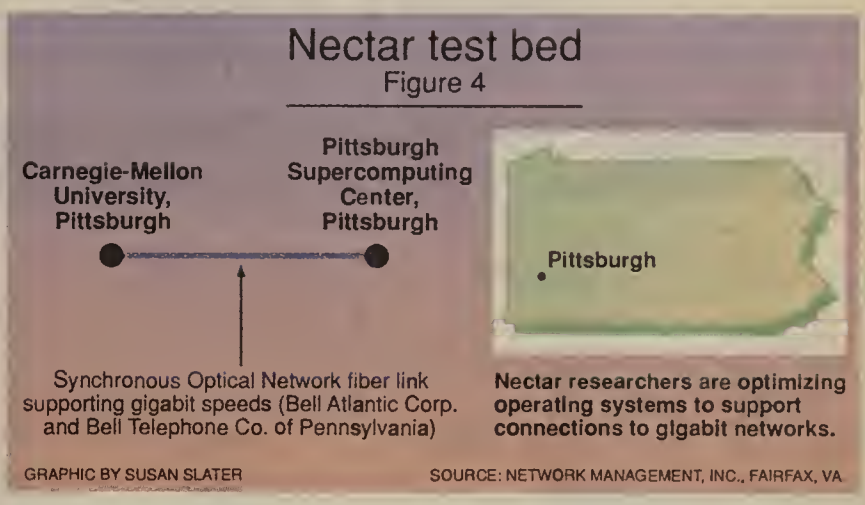
Aurora researchers are also developing fast, efficient low-overhead protocols for use on multigigabit networks, says Bruce Davie, project manager in Bellcore's Information Networking Research Laboratory in Morristown, N.J. Bellcore and MIT are developing a transport-layer protocol that provides flow control, error recovery, congestion control and datagram services. This new protocol will be geared to supporting traffic with diverse QOS requirements.

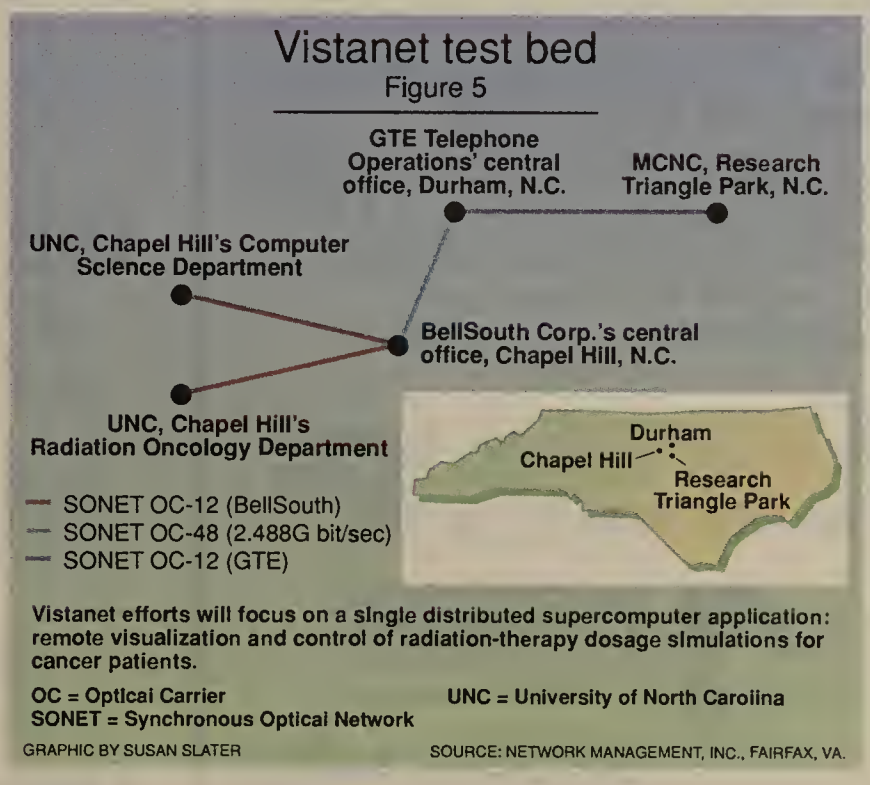
A focus of Aurora protocol research, says MIT's Clark, is to uncover any bottlenecks that will make implementations of existing protocols difficult to adapt to high-speed networks.

For example, protocol implementations can be speeded by integrating them more tightly with host operating systems and hardware platforms, he says. The goal is to derive the maximum network throughput for any given level of CPU utilization.

Blanca

Blanca is the only multigigabit network test bed that will link sites on both coasts as well as the nation's midsection. Participating sites include AT&T Bell Laboratories in Murray Hill, N.J., Cray Research, Inc. in Minneapolis; the National Center for Supercomputing Applications (NCSA) in Champaign-Urbana, Ill.; the University of Illinois in Champaign-Urbana; the University of Wisconsin-Madison; the University of California-Berkeley; and Lawrence Berkeley Laboratories in Berkeley, Calif. Participating carriers include AT&T and some RBHCs (see Figure 2, page 44).





The Blanca test bed network will be an upgrade to an existing research network, the Experimental University Network (XUNET), which since 1986 has linked Bell Labs' Murray Hill facility to University of Wisconsin, the University of Illinois in Champaign-Urbana and the University of California-Berkeley.

Plans call for XUNET's existing T-1 cross-country backbone links to be replaced by T-3 connections and then, at an unspecified date, by SONET OC-12 circuits, says Domenico Ferrari, computer science professor at the University of California-Berkeley.

The Blanca network will use prototype ATM cell-relay switches from AT&T, says Larry Landweber, computer science professor at the University of Wisconsin-Madison. These switches will interface to researchers' computers via high-speed channel connections conforming to the ANSI High-Performance Parallel Interface (HPPI) draft standard.

HPPI specifies an 800M bit/sec, point-to-point digital link made up of two simplex channels, one in each direction. Currently, each channel contains 50 twisted pairs. HPPI channels transfer data as 32-bit-wide "words." The specification allows channel-oriented host computers to support the highest performance connections available from the hosts. HPPI links must be circuit-switched, which makes them unsuitable for multipoint applications.

The University of Wisconsin is working on developing HPPI adapters to provide fiber-optic interfaces between the ATM switch and remote supercomputers used by Blanca researchers.

Blanca's cross-country topology will allow researchers to study the impact of propagation delays on real-time gigabit WAN management systems, says Sandy Fraser, executive director of Bell Labs' Information Sciences Research Division in Murray Hill. Round-trip signal-propagation delays between network management systems and the remote devices they control may limit the effectiveness of centralized congestion-control schemes.

"On bicoastal networks, there would be a long feedback loop for real-time network management control," he says. This could pose a problem when congestion on packet switch buffers and other network resources fluctuates too rapidly for remote network-control centers to monitor and intervene.

A paradox mentioned frequently by gigabit network researchers is that even the fastest speed available — the speed of light — may be too slow for some WAN applications. Supercomputer applications that depend on microsecond response between concurrent, parallel processes may suffer when ported to distributed WAN platforms. Generally, the closer the intercommunicating components, the shorter the signal-propagation delay.

Several supercomputer applications will be accessed across the Blanca net, including radio-astronomy imaging, multimedia digital libraries, medical imaging, and concurred visualization and control of many simulations running on several remote computers. The applications will reside on networked supercomputers at Cray Research, Inc., NCSA and University of Wisconsin. University researchers in such fields as computer science, data communications, space science and atmospheric modeling will have remote access via Blanca to the supercomputers.

Blanca research and development activities are to some degree application-driven, says University of Wisconsin's Landweber.

Blanca's researchers will closely monitor the performance of the network's applications and use these findings to modify and

(continued on page 52)

NREN fiscal and political prospects

Actual implementation of the National Research and Education Network (NREN) depends on whether the project can obtain sufficient multiyear federal funding — no easy feat in a fiscal climate strained by deficit, recession and war. However, strong bipartisan support exists for a national high-speed network, as evidenced by President Bush's 1992 fiscal-year budget — which would set aside nearly $150 million for NREN — and by bills recently introduced on Capitol Hill.

NREN proponents have identified a multigigabit national network as a strategic resource for U.S. competitiveness into the next century. The Bush administration agrees, calling it one of the precompetitive generic technologies worthy of federal funding.

The High-Performance Computing Act of 1991, introduced in January by Sen. Albert Gore (D-Tenn.), calls for the National Science Foundation (NSF) to work with other federal agencies to establish a multigigabit NREN by 1996.

NREN moneys would go to the NSF, the Defense Advanced Research Projects Agency (DARPA) and other federal agencies.

Under Gore's bill and a companion measure introduced in the House by Rep. George Brown Jr. (D-Calif.), DARPA would be in charge of developing high-speed networking technologies for NREN, while the NSF would implement and administer the operational net.

According to Richard Binder, president of the Corporation for National Research Initiatives, which is coordinating NREN, the commercial participants in the five test beds have contributed far more to the project than the U.S. government's $15.8 million in seed money, appropriated last year.

Binder estimates that the commercial contributors — including AT&T, GTE Corp., IBM, MCI Communications Corp., the regional Bell holding companies and US Sprint Communications Co. — have chipped in about $100 million worth of manpower, facilities, hardware, software and transmission circuits and services.

— James Kobielus

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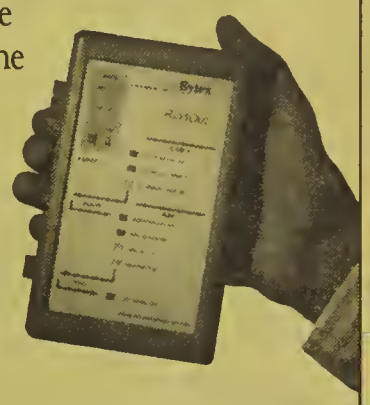

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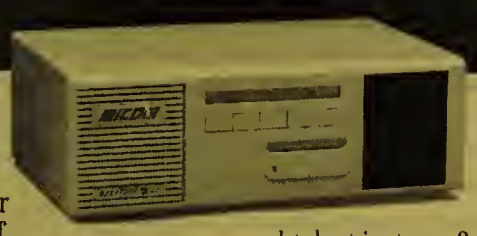

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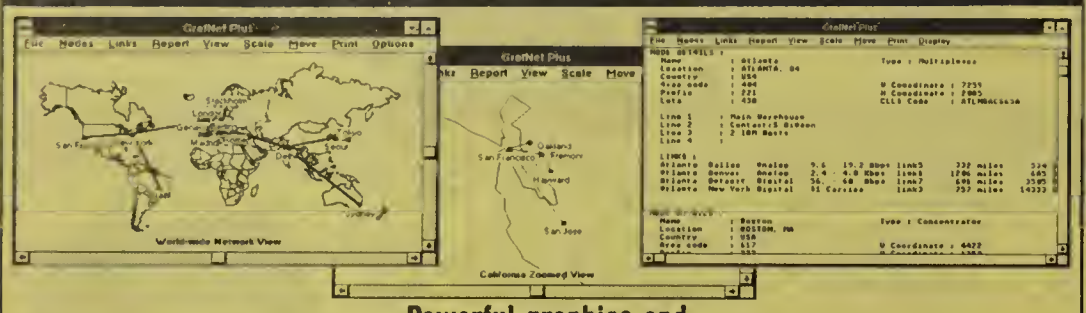

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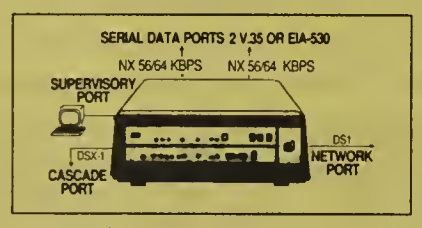

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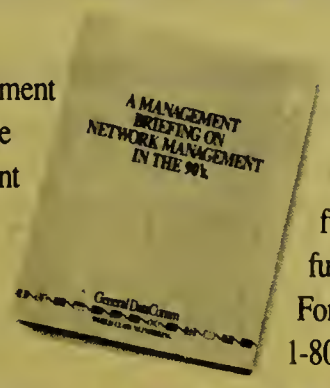

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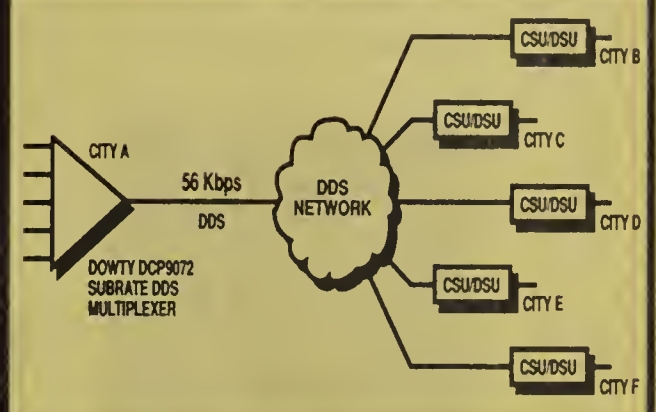

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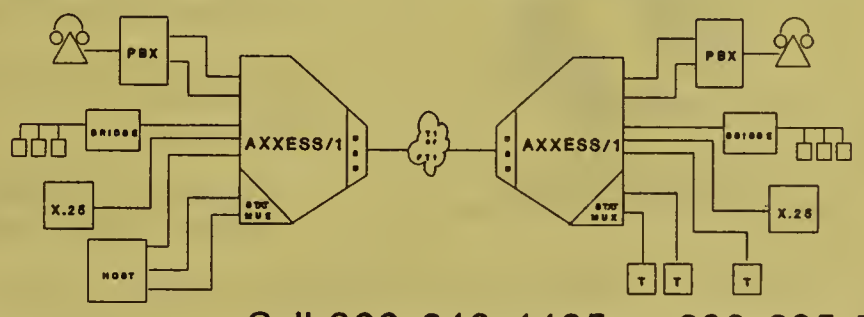

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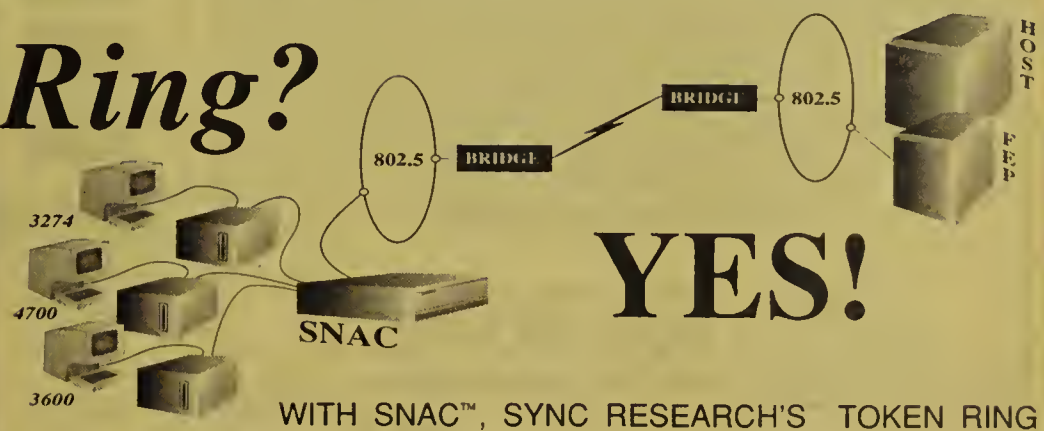

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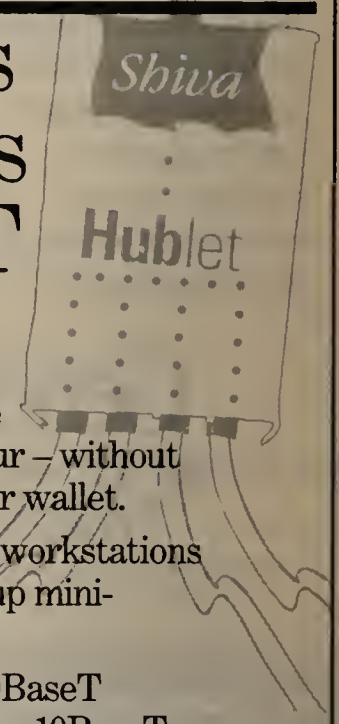

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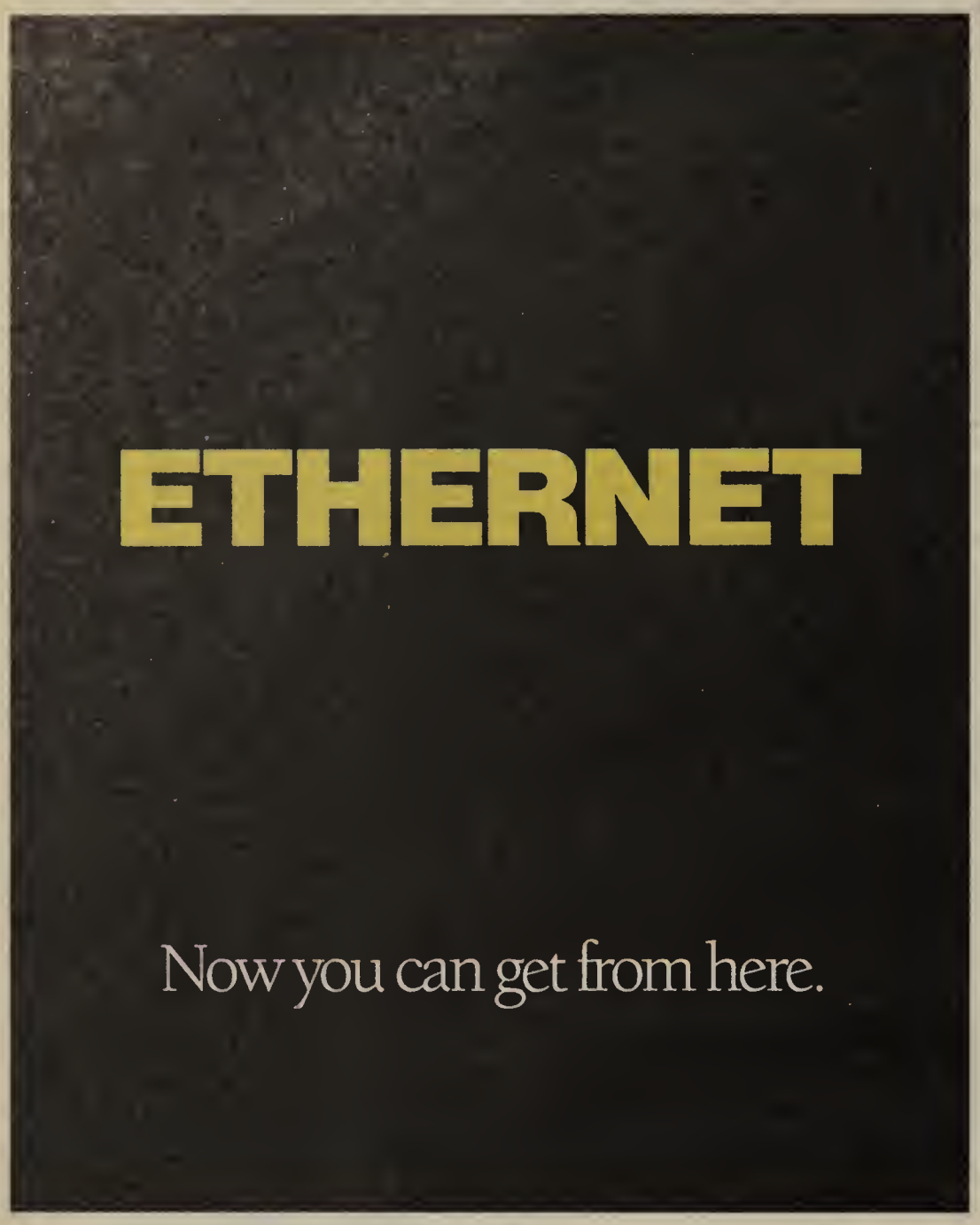
Sept. 23	Wed., Sept. 11
Sept. 30	Wed., Sept. 18
Oct. 7	Wed., Sept. 25



Agency brands tests inconclusive

continued from page 2

band. Both sides monitored the microwave links to determine whether radio transmissions were affected by PCN America signals.

Based on its interpretation of the test findings, PCN America had urged the FCC to permit wireless communications operators to use the 2-GHz radio frequency. They would use this frequency to offer a voice service that would let customers use pocket-size portable telephones. But energy and transportation users found just the opposite and voted against the idea of sharing frequencies.

The FCC said the test results, which were submitted separately by PCN America and HAMUG, are inconclusive.

"We find that the test program . . . does not provide sufficient information to support a determination at this time that sharing between [personal communications services] and microwave users is feasible," the letter said.

Need for filtering equipment

In its post-test report for the FCC, PCN America admitted that its system interfered with transmissions over microwave in the 2 GHz band. The company said that to avoid interference in the future it would have to furnish its wireless system with special filtering equipment and power systems.

In their comments, HAMUG and the American Petroleum Institute raised questions about the effectiveness of the special gear. The FCC cited these concerns in its decision to block PCN America from proceeding with the next stage of its project, a market test of its personal communications service.

The letter detailed several steps PCN America must take, including more testing, before proceeding with its full-market test.

Issues must be addressed

The FCC wants PCN America to demonstrate the technical and operation feasibility of using the special filtering and power systems it mentioned in the report. The FCC also wants the carrier to operate its transmitters and handsets at various antenna heights. "The height issue is an important one," said the FCC's Stanley. "The height of the [transmitter] antenna plays a critical role in the determination of whether there is interference with microwave [systems]."

Private microwave users hailed the FCC's actions, maintaining that frequency sharing without interference is impossible, while PCN America said it expected the setback and plans to perform additional testing and push on with the project.

Stanley really knocked the legs out from under them, said one Houston-based microwave user who requested anonymity.

But PCN America is taking the FCC letter in stride. "We still characterize the Houston test as a successful one," said David Frear, chief financial officer for Millicom, Inc., the New York-based firm that owns PCN America. "I can't say we are alarmed by what the FCC asked because we expected it."

Frear said the company will meet the FCC's requirements and conduct the extra testing.

Cultivating high-speed nets

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optimize network architecture and component design.

Casa

The Casa test bed net will link four research sites in the Southwest: Los Alamos National Laboratory (LANL) in Los Alamos, N.M.; San Diego Supercomputing Center in San Diego; and two Pasadena, Calif., sites, the California Institute of Technology and the Jet Propulsion Laboratory. Participating carriers include MCI, Pacific Bell and US West, Inc. (see Figure 3, page 44).

Casa has a strong application emphasis, according to Reagan Moore, manager of programming and software services at the San Diego Supercomputing Center. "Casa's focus is to demonstrate that a single application can effectively use an 800M bit/sec circuit for two-way distributed computing," he says.

In keeping with this focus, Casa researchers are engineering tightly coupled, distributed supercomputer applications to run in a very-high-bandwidth WAN environment. Application functions and data will be "decomposed" and run on separate supercomputers interoperating over long distances, Moore says.

He points out that one approach toward speeding execution of distributed applications is to match process characteristics to machine types — for example, putting scalar processes on scalar machines and parallel processes on parallel machines.

The resulting application speedups offset whatever delays result from the WAN protocol overhead required for communication between the dispersed processes.

From an engineering standpoint, Moore says, two of Casa's main goals are to maximize WAN bandwidth utilization and to minimize supercomputer CPU time and operations spent on driving WAN transmission protocols. These goals may be in conflict, he notes, because increasing the amount of data shipped across the network usually requires that more CPU time be devoted to protocol-driver functions than to application processing.

The Casa network may be operational by year end under the most optimistic scenario, says John Morrison, leader of LANL's Network Engineering Group. At each site, HPPI crossbar switches from Network Systems Corp. (NSC) will connect local systems with carrier-provided SONET fiber-optic links.

Still under development at LANL are two other essential pieces of hardware: HPPI adapters that will link site supercomputers to the premises-based NSC crossbar switches, and HPPI-to-SONET adapters that will interface the switches to long-haul fiber facilities.

Nectar

The Nectar test bed will connect two sites in the Pittsburgh metropolitan area: Carnegie-Mellon University (CMU) and the Pittsburgh Supercomputing Center. Bellcore is developing Nectar's high-speed LAN/WAN interfaces; the only carrier involved is Bell Telephone Co. of Pennsylvania (see Figure 4, page 45).

Nectar currently uses T-1 and 100M bit/sec facilities. The test bed will be upgraded to gigabit speeds using NSC's HPPI crossbar switches, Bellcore-developed HPPI-to-SONET switches and LAN interfaces, and host-computer HPPI channel interfaces, according to H.T. Kung, a computer science professor at CMU.

Nectar research is divided between network infrastructure and application design issues. A chief infrastructure research topic is optimizing computer operating systems to manage very-high-speed applications and connections.

To do this, Nectar researchers must design operating systems that impose minimal overhead on net communications, reduce buffering requirements and permit direct memory access by intercommunicating distributed processes, Kung says.

Researchers from CMU's computer science department are working with other departments, such as the graduate business and chemical engineering schools, to engineer distributed supercomputer applications that take advantage of gigabit net speeds.

Vistanet

Vistanet will link two North Carolina research organizations — the University of North Carolina in Chapel Hill, and MCNC, a state research consortium in Research Triangle Park — by means of two interconnected local exchange carriers, BellSouth Corp. and GTE Telephone Operations (see Figure 5, page 45).

Like Aurora, Vistanet is using two alternative switching architectures. BellSouth will install a prototype Fujitsu ATM switch at its Chapel Hill central office, while GTE will deploy in its Durham, N.C., central office a prototype broadband circuit switch developed at GTE Labs.

Connecting the two central offices will be 2.488G bit/sec SONET OC-48 fiber links. SONET OC-12 links will connect two University of North Carolina sites to the BellSouth central office; another SONET OC-12 facility will connect MCNC's North Carolina Supercomputing Center to the GTE central office. HPPI-to-SONET interfaces that will link site computers to the central office switches over fiber-optic lines are still under development.

The full-speed gigabit network is expected to come on-line by year end, says Vernon Chi, director of the university's Microelectronic Systems Laboratory. Currently, Vistanet uses T-3 links.

Vistanet is used for one distributed supercomputer application: remote visualization and control of radiation-therapy dosage simulations for cancer patients. This application is expected to generate bursty, image-intensive network traffic, says Daniel Stevenson, manager of communications research at MCNC.

Vistanet researchers are developing traffic models for determining which transport-layer protocols are best suited for the test bed's sole application. The transport protocols they are exploring include the Transmission Control Protocol, Express Transfer Protocol and the Versatile Message Transport Protocol.

Strong commitment

Together, these five test beds are creating the infrastructure for the next wave in information technology. Each is developing a network architecture capable of handling all types and grades of traffic — voice, data, image and video — through fully integrated facilities. In the process, these test beds are ushering in the era of widespread visual and multimedia computing, where the distinctions between telephony, computers, television and other media will someday dissolve.

Users press on with GOSIP trials

continued from page 1

oped by groups such as the International Standards Organization and Consultative Committee on International Telephony and Telegraphy ("Government agencies prep nets for GOSIP compliance," *NW,* Aug. 6, 1990).

GOSIP Version 1.0 calls for federal agencies to use X.25 packet switching, X.400 Message Handling System (MHS) and File Transfer, Access and Management standards, as well as IEEE 802.3 Ethernet, 802.4 token bus and 802.5 token-ring local-area network standards.

Through a phased-in approach, the goal of GOSIP is to gradually bring interoperability to government computer systems and networks through use of standards-based products. Both the Defense Department and the VA have led the charge to GOSIP by issuing a spate of contracts (see graphic, this page).

One factor slowing GOSIP's assimilation into government networks is that users are finding they must tinker with OSI products.

"These products just don't come shrink-wrapped and ready to use," said Robert Cooney, division head of research development, test and evaluation at the Navy's Naval Computer and Telecommunications Command here. Many agencies are sinking hours of manpower into testing products to ensure they are network-ready, as opposed to just GOSIP-compliant.

Another factor slowing GOSIP is the federal procurement system, in which users send out requests for information, followed by requests for procurements and then extensive testing on prototypes or deliverable products. The process can take months, even years, until a final award is made, as losing bidders can delay the order by protesting an award.

Still, a number of federal agencies are making headway with various GOSIP projects.

Cooney said the Navy has implemented two application-layer X.400 gateways that enable users on Navy networks to send electronic mail to users on the Transmission Control Protocol/Internet Protocol-based Internet.

The Navy's experiments during the last two years with X.400 have resulted in functioning gateway prototypes that it plans to share with other federal agencies. The experiments have also enabled the Navy to groom a growing pool of engineering talent to cope with the move to OSI.

By year end, the Navy, in cooperation with the Army and the Defense Logistics Agency, plans to issue a request for proposal for its GOSIP gateway procurement. If all remains on track, the GOSIP gateway contract, envisioned as a purchasing source for all the defense agencies, would be awarded in the first quarter of 1992.

According to David Garrett, the Army's systems engineer for the Defense Message System, government users are gaining experience by using current OSI standards, even though newer versions will provide more functionality. He said the Army will launch a project in October to replace 14 proprietary E-mail systems that serve 1,500 users at the Pentagon with X.400.

Garrett noted that one drawback of the 1984 version of the X.400 standard is that it did not provide for remote accessing of messages. This limitation was overcome by the 1988 X.400 standard, but products conforming to that version are not widely available today.

He said the limitation can be overcome in a Unix environment by connecting a dumb terminal running a remote access program to the Unix computer. However, no satisfactory makeshift solution is available for the DOS environment.

Although remote access is not an important requirement in the Pentagon's initial X.400 installation at present, Garrett emphasized that the Army, cognizant of the improvements in the X.400 1988 version, does not plan to implement a large number of the 1984 X.400 products due to that limitation. But using 1984 X.400, which is compatible with 1988 X.400, is a valuable experience for users, he noted.

In a related effort, the Army this fall will also connect the new Pentagon X.400-based system to the Internet using an X.400 MHS gateway.

The Air Force is also moving ahead with its GOSIP deployment plans. At Gunter Air Force Base in Montgomery, Ala., the agency this past July completed installation of an 11-node X.400 network that integrates three Unisys Corp. 2200 mainframes running the Unisys X.400 1988-version software along with Retix 1984 X.400 software operating on three AT&T 3B2-600G minicomputers and three AT&T Intel Corp. 80386-based personal computers.

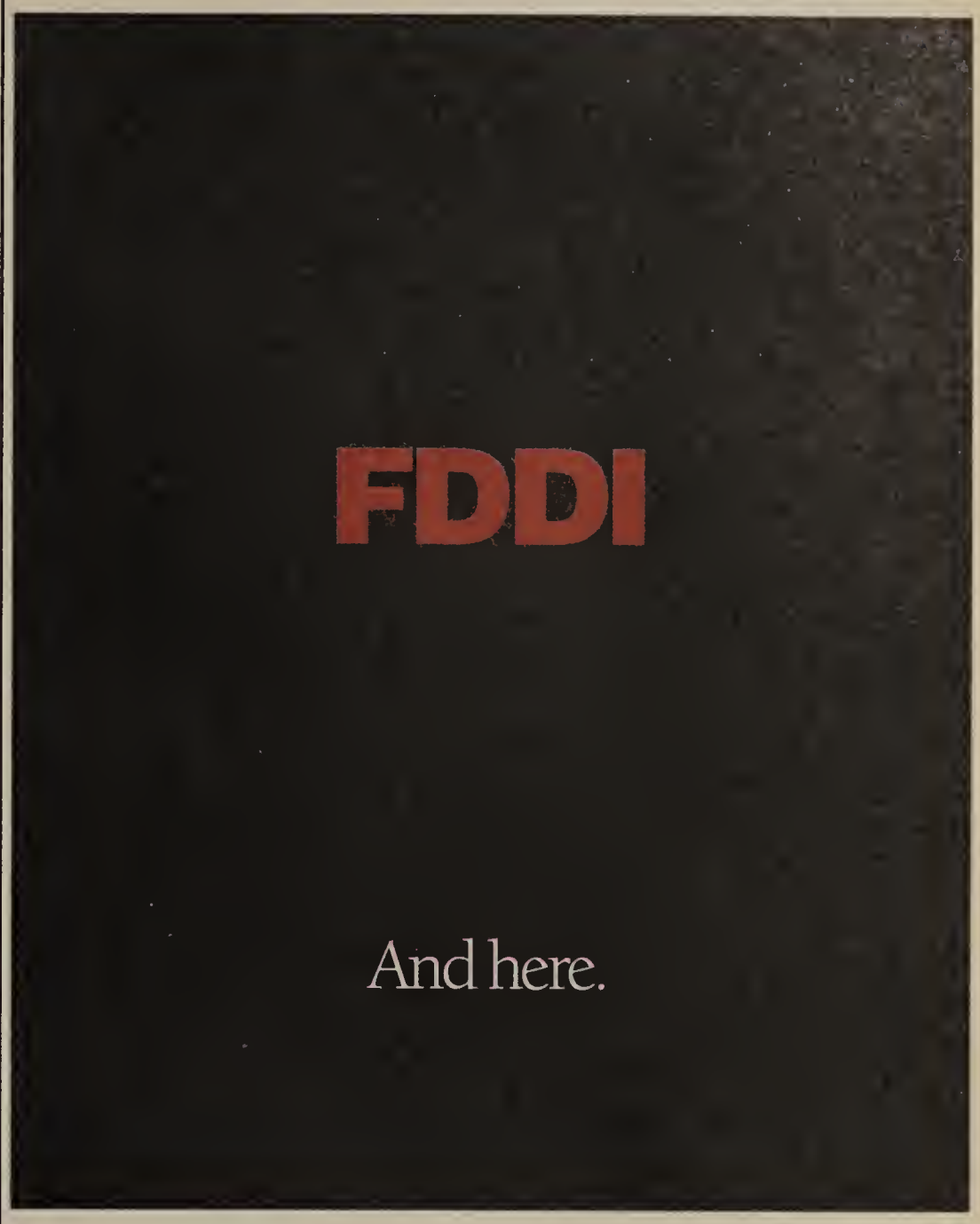
The VA's Houser said the agency's Nationwide Office Automation for Veterans Affairs contract, finalized with Lockheed Corp., will begin to move VA offices to GOSIP nets. The VA now has three X.400 gateways running on Data General Corp., Digital Equipment Corp. and Wang Laboratories, Inc. VAX computers. But Houser emphasized the VA has not yet ironed out a strategy for bringing interoperability to the VA's 350 sites.

"We're actively evaluating what architecture might be appropriate," he said.

Federal procurements for GOSIP products

Contract	Date	Agency	Awarded to
Standard Multiuser System Computer Requirements Contract	Dec. 1988	Air Force	AT&T Federal Systems Division
Desktop III	Dec. 1989	Air Force	Unisys Corp.
Small Multiuser Contract	July 1990	Army	Electronic Data Systems Corp.
Nationwide Office Automation for Veterans Affairs	Dec. 1990	Department of Veterans Affairs	Lockheed Corp.
Lightweight Computer Unit	May 1991	Army	Science Applications International Corp.
Operations Automation Data Processing	May 1991	NASA	IBM (under protest)
Treasury Multiuser Acquisition Contract	July 1991	IRS	AT&T (under protest)

GRAPHIC BY SUSAN J. CHAMPENY — SOURCE: *NETWORK WORLD*



Preparedness pays off as Bob hits East Coast

By Maureen Molloy
Staff Writer

As Hurricane Bob stormed its way through the mid-Atlantic and Northeast coastal regions last Monday, network managers at corporations throughout the areas scrambled to mitigate potential damage to their networks.

Most net managers said they prepared by bringing down mission-critical applications before the hurricane's scheduled arrival. This move — along with well-developed disaster recovery plans — allowed most businesses to weather the storm without suffering lingering network outages.

"Basically, our network survived in excellent shape, except for electrical power outages at some local sites that were beyond our control," said Robert Drum, executive vice-president of Fleet/Norstar Financial Group, Inc., a financial institution based in Albany, N.Y. "The hurricane served as a good reminder of the importance of developing contingency plans."

Bob, estimated to be one of the most financially devastating hurricanes to strike the region this century, caused an estimated $1 billion worth of damage throughout New England.

Ironically, Fleet/Norstar is currently in the midst of converting to a satellite communications network to better secure its operations against such natural disasters.

"We've found that our weakest link in the network is the land lines," Drum said. "Uptime reliability is much greater with a satellite network since it eliminates the land lines that typically cause the most problems during a natural disaster."

The firm currently has a T-1 network that links 21 branches to the corporate data center in Albany. Although none of the 10 T-1 lines linking branches in Rhode Island and Long Island, N.Y., to headquarters were damaged, nearly 300 automated teller machines located in the hurricane belt were knocked out of service from one to three days.

Other companies had to revert to network contingency plans.

Boston Edison Co. lost a leased line between its Boston headquarters and a generating station 30 miles away, but the company had a backup microwave channel in place to route traffic between the two sites.

Massachusetts General Hospital did just the opposite. It switched over from a microwave net to an alternate cable link so the hospital could communicate with its central computing center outside Boston.

"The constant and heavy sheets of rain interfered with our microwave signals, so we had to switch to the cable," said Richard Crane, the hospital's director of communications. "Transmission was slower because the cable doesn't have as high a capacity as the microwave, but it was reliable and that's what mattered most."

The storm also knocked out telephone service for about 40,000 New England Telephone and Telegraph Co. customers, according to a spokesman for the carrier. More than 85 central office switches throughout the region were placed on auxiliary generators.

Banyan unwraps net capabilities for Unix

continued from page 1

tegrate SCO Unix with DOS, Apple Computer, Inc.'s Macintosh and Microsoft Corp.'s Windows environments.

During a presentation at the annual SCO Forum91 here, D'Arezzo declined to say much more about the joint development effort than that products would be available in the first half of 1992. He did say, however, that another relationship would be announced shortly, although he declined to name the company.

Some sources speculate that Banyan's next relationship will be with a vendor of application software, possibly even a data base company. A software vendor could use Banyan's network services software to allow an application to be distributed and managed across a wide-area network.

In an interview after the press conference, D'Arezzo acknowledged that Banyan is at work on providing Simple Network Management Protocol (SNMP) support for its network management software, as well as X.500 capabilities. Sources said the company may announce SNMP support at the INTEROP 91 Conference and Exhibition in October.

Analysts applauded Banyan's announcement. "The LAN market needs Banyan's technology very badly — it's just a question of what [Banyan] will do since they haven't announced the specifics," said Jamie Lewis, editor in chief of the *Clarke Burton Report* in Salt Lake City.

Earlier this year, Dave Mahoney, Banyan's president and chief executive officer, said the company would break out its StreetTalk global naming service and other network services, including security, messaging and network management features, from the Unix-based VINES to make them available to other software suppliers ("Banyan to open VINES net services," *NW,* May 13).

Banyan has won praise for StreetTalk, which uses a three-part naming scheme to manage user names, data and network resources transparently across geographically dispersed networks.

Winning praise

As part of its announcement last week, Banyan said it will base future versions of VINES on SCO Unix and other standard Unix platforms, rather than the current proprietary Unix implementation on which the network operating system is based. That, D'Arezzo said, would free the company from further Unix operating system development and allow it to concentrate all of its resources on the development of its network services software.

Until now, Banyan has been criticized by analysts and users for relying on its proprietary implementation of Unix, which limited the backing of third-party applications developers and hardware vendors.

"If this relationship allows Banyan to spend more time on its network service instead of tweaking Unix, it's an excellent move" said Brice Bonwill, president of Systems and Network Solutions, a consultancy in the Washington, D.C. area.

The SCO agreement offers Banyan broad reach into a new market. SCO Unix is available for a wide array of computers and boasts over 4,000 compatible applications. SCO gets a boost in large corporations and government agencies, where Banyan has focused its sales efforts.

New EDI message standard criticized

continued from page 2

ests of the marketplace," said Gary Dalton, business manager at AT&T EasyLink Services in Bridgewater, N.J.

AT&T EasyLink was one of four companies in the ANSI Communications Subcommittee that initially opposed adopting the Mailbag standard. The other firms were Digital Equipment Corp., GE Information Services and Telecom Canada. However, all the dozen or so service providers in the market today have now agreed to cooperate on implementing the Mailbag standard. They met earlier this month to map out implementation guidelines.

Dalton said Mailbag doesn't provide an end-to-end audit trail of EDI messages the way X.400 does. Also, unlike X.400, Mailbag doesn't specify a way to inform end users that an EDI message either can't be delivered or has been delivered to the recipient's mailbox and retrieved.

> "Mailbag is a quick fix that doesn't solve many of the problems users face on a weekly basis," Lyons said.
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"Mailbag is a quick fix that doesn't solve many of the problems users face on a weekly basis," said Robert Lyons, a technical specialist at AT&T EasyLink Services.

But proponents of Mailbag said the standard solves the most troublesome of all interconnection problems: data that gets lost in transmission between two networks.

The Mailbag standard specifies that a receiving network must notify the sending network within a predefined period of time that it has accepted and stored an EDI message, said John Stelzer, senior EDI consultant at the Dublin, Ohio-based Ordernet Services Division of Sterling Software, Inc.

Delaying the arrival of X.435

While most users agree that Mailbag is a positive step, some feel strongly that it will impede the implementation X.435.

"We voted against Mailbag because it's inferior to X.435 and the network providers will use it as an argument to delay the expense of implementing X.435," said Betty Zimmerman, EDI coordinator for information systems at Texaco, Inc. in Houston. Texaco cast the lone dissenting vote against the standard at the June membership meeting of ANSI X12. Eight other ANSI members approved it with dissenting comments.

But supporters say Mailbag is an interim step on the way to X.435 and a better short-term alternative for improving interconnection reliability than trying to jury-rig X.400 to handle EDI traffic. Most network providers say they plan to implement X.435 once software becomes available in about two years.

To implement X.400 gateways for EDI, EDI carriers would have to agree on coding conventions for identifying X.400 messages that carry EDI as opposed to other traffic, such as electronic mail messages, graphics or facsimile, said Stelzer.

In addition, implementing X.400 gateways would require many of the 13 EDI service providers in the market today to convert from Binary Synchronous Communications protocols to X.25, which would cost as much as $500,000 and entail considerable time and effort, he said.

In contrast, Mailbag is platform- and protocol-independent, which means that most vendors will be able to implement a test version of the standard in three to four months at a minimal cost, Stelzer said.

But others argue that Mailbag proponents overestimate the time and expense of implementing X.400 gateways for EDI. "It's not an overwhelming exercise to get connected through X.400," said Laurel Whitehouse, EDI standards consultant at DEC in Nashua, N.H. "It shouldn't take more than six months."

Whitehouse said many EDI service providers in Europe have already interconnected their networks using X.400. She also points to U.S. E-mail carriers that, under pressure from the aerospace industry, managed to establish fully functional X.400 gateways between all their networks in two years.

"In retrospect, considering the amount of time EDI carriers have spent developing Mailbag, they could have implemented X.400," she said.

Two carriers that have already implemented an EDI X.400 interconnection gateway are AT&T EasyLink and Telecom Canada, which operates the TradeRoute EDI network.

Both have agreed to use the X.400 P0 protocol to define EDI messages and the P2 protocol to define electronic messages, AT&T's Dalton said.

"Establishing an X.400 gateway is not that difficult, and it's a graceful way to grow into X.435," he said. "It seems so logical to me, I don't know what the problem is."

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Beta tester lauds MCI's switched T-1

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annual conference last September, MCI's Virtual Private Data Service (VPDS) enables users to establish a dial-up T-1 link as needed to support high-capacity applications.

The service complements MCI's existing switched 56K bit/sec and switched 64K bit/sec services ("MCI pledges switched T-1, T-3 services," *NW,* Oct. 1, 1990).

The switched T-1 service is supported on MCI's Digital Data Network, an all-digital subnetwork of Digital Switch Corp. digital access and cross-connect systems (DACS) interconnected with fiber-optic facilities.

> "In our disaster recovery application, where the cost of downtime is tremendous, backup in the shortest time possible is a major benefit," Casagrande said.
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GE Capital currently buys capacity in fractional T-1 chunks on GE's nationwide T-1 backbone network, which was constructed in the late 1980s under an AT&T Tariff 12.

Large GE Capital sites use multiple T-1s to access their network, Casagrande said.

Super clean

In June, GE Capital began testing the MCI switched T-1 service to back up a dedicated T-1. This T-1 was used to link a 4M bit/sec IBM Token-Ring Network at its Merriam, Kan., site to a mainframe at its data center here.

In one instance, GE Capital kept the switched T-1 link up for 36 hours during which time the company's network control center said it monitored a bit error rate of 10^{-8}, which is MCI's guaranteed level. "The circuit was super clean," Casagrande said.

The switched T-1 circuit exceeded MCI's 99.9% guaranteed availability level. "We are very pleased with the availability of the circuit," he said. "We need the highest availability level for our backup applications."

The company was able to establish the switched T-1 circuit faster than it had expected.

"We thought it would take a while to set up the link, but we found that we could consistently establish the circuit in one-half to two seconds," Casagrande said. "In our disaster recovery application, where the cost of downtime is tremendous, backup in the shortest time possible is a major benefit."

In order to establish a switched T-1 link, GE Capital dials a 10-digit number from the keypad of an on-site DOS-based personal computer, which is equipped with MCI-developed communications software that provides access to a DACS in the MCI network over a 9.6K bit/sec private line.

In the future, the MCI switched T-1 will be used as a backup in the event of either a T-1 outage or an IBM 3745 failure to enable GE to reestablish connectivity via bridges.

But the company won't be restricting its use of switched T-1 to backup applications. GE Capital plans to use the switched T-1 service to enable remote LAN users to exchange files. The company said it doesn't believe the circuit setup time of under two seconds will be a problem in that application.

The company may also eventually use switched T-1 to support an imaging application that is currently in the planning stage.

With this application, remote GE Capital offices could access an image system and either download or upload images.

In both cases, switched T-1 would be easier and more effective to use than multiple switched 56K bit/sec links.

"We have about 20 locations where we'd like to replace numerous switched 56 circuits with switched T-1 or switched 384K bit/sec service," Casagrande said.

MCI's future plans

Casagrande urged network managers to undertake a cost analysis before purchasing switched T-1 for existing or emerging applications.

But performing such an analysis today is difficult because MCI has divulged little about the deployment and pricing of the service.

However, in an interview with *Network World,* MCI Senior Data Product Marketing Manager Marty Burak filled in some of the blanks about the switched T-1 offering.

MCI will offer the service in over 100 cities by year end and expects to add 100 more by the end of May 1992, he said. By comparison, AT&T currently offers its switched T-1 service in 14 cities and will add others based on customer demand. US Sprint Communications Co. has not yet announced a switched T-1 offering.

According to Sue Wilkins, MCI's VPDS product manager, MCI would tariff the service as planned in the third quarter of 1991.

> "We have about 20 locations where we'd like to replace numerous switched 56 circuits with switched T-1 or switched 384K bit/sec service," Casagrande said.
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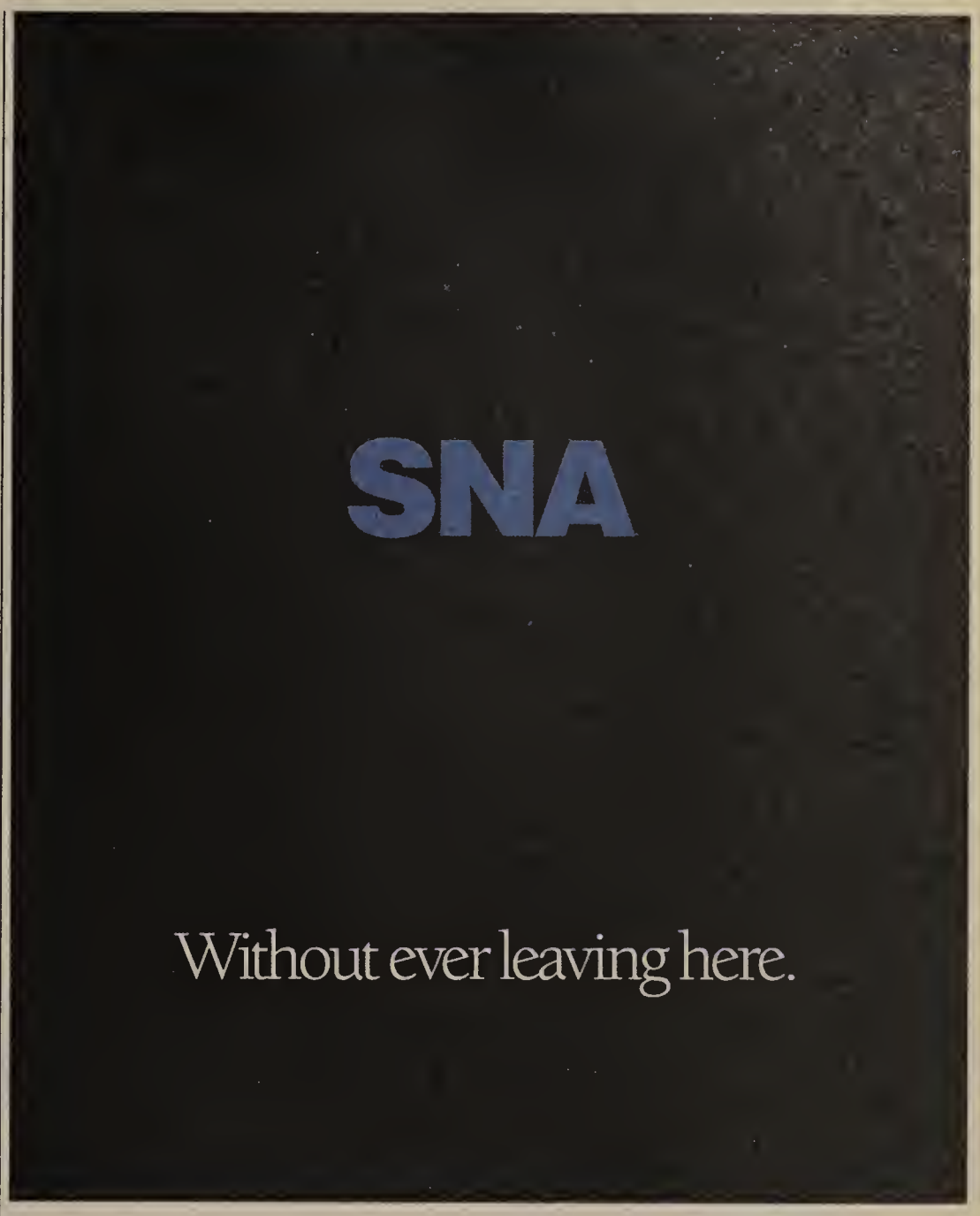
While still not disclosing pricing, Burak said MCI will price switched T-1 below AT&T's switched T-1 offering.

"It's a certainty. We think AT&T has made a mistake by pricing its service too high," he said.

AT&T's Accunet Switched 1536 costs $3.1050 for the first 30 seconds and $.2370 for each additional six-second period for a circuit up to 55 miles long.

AT&T charges $5.1740 for the first 30 seconds and $.6508 for each additional six seconds for a circuit over 3,000 miles in length.

Burak said MCI's switched T-1 service is generally cheaper than private lines for users whose applications need two to four hours of daily connect time.



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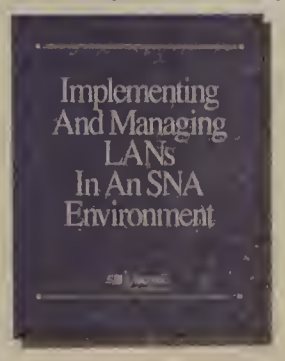

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